Operational Applications for Lightning Data during Tropical Cyclones

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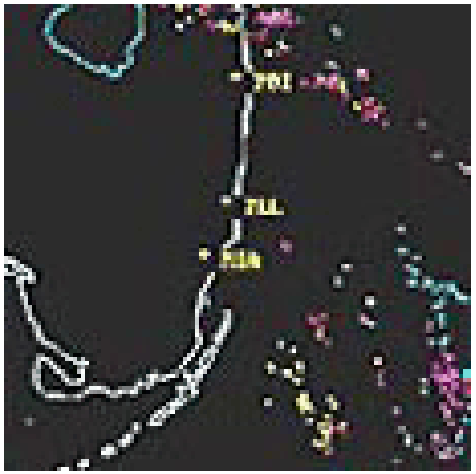
Operational Applications for Lightning Data during Tropical Cyclones

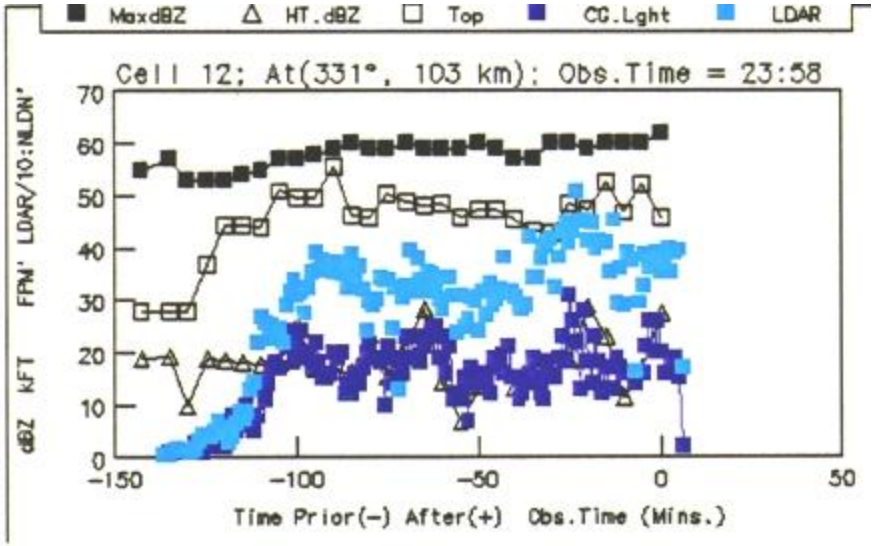
- WFO MLB history with lightning detection systems (the past to the future)
- Florida lightning climatology versus casualties (threat during TCs?)
- Lightning signals associated with TC inner/central rainbands
- Lightning signals associated with TC outer rainbands
- Review of TC Warning Operations (how beneficial is lightning information?)
- Conclusions

•Electric Field Mill

• National Lightning Detection Network (NLDN)

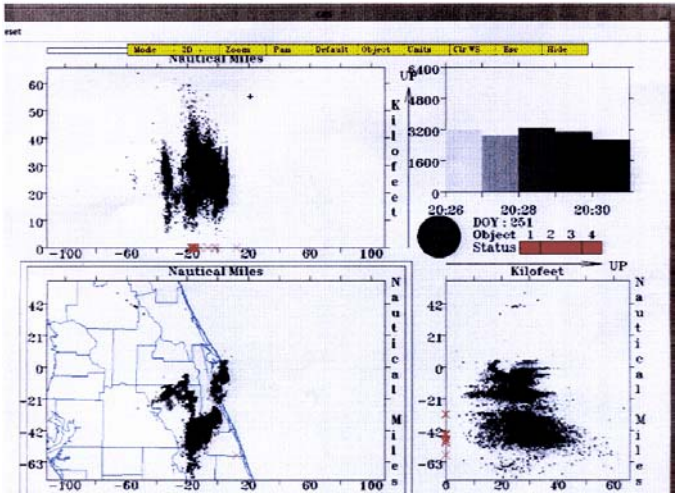


•Lightning Imaging Sensor Data Applications Display (LISDAD)

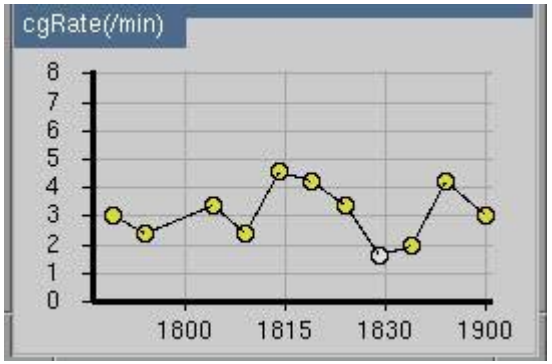


•Lightning Position And Tracking System (LPATS)

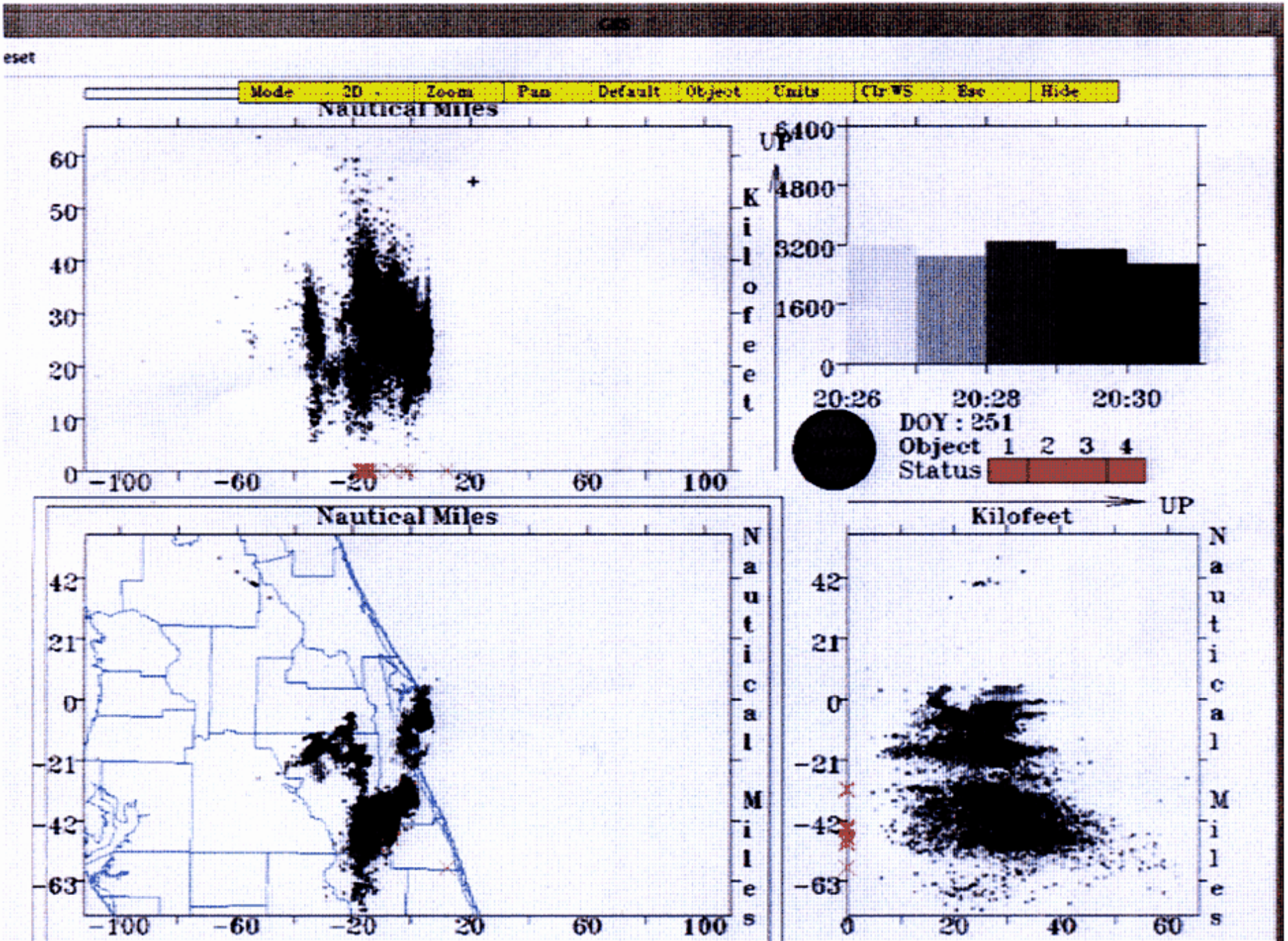
•Lightning Detection And Ranging (LDAR)



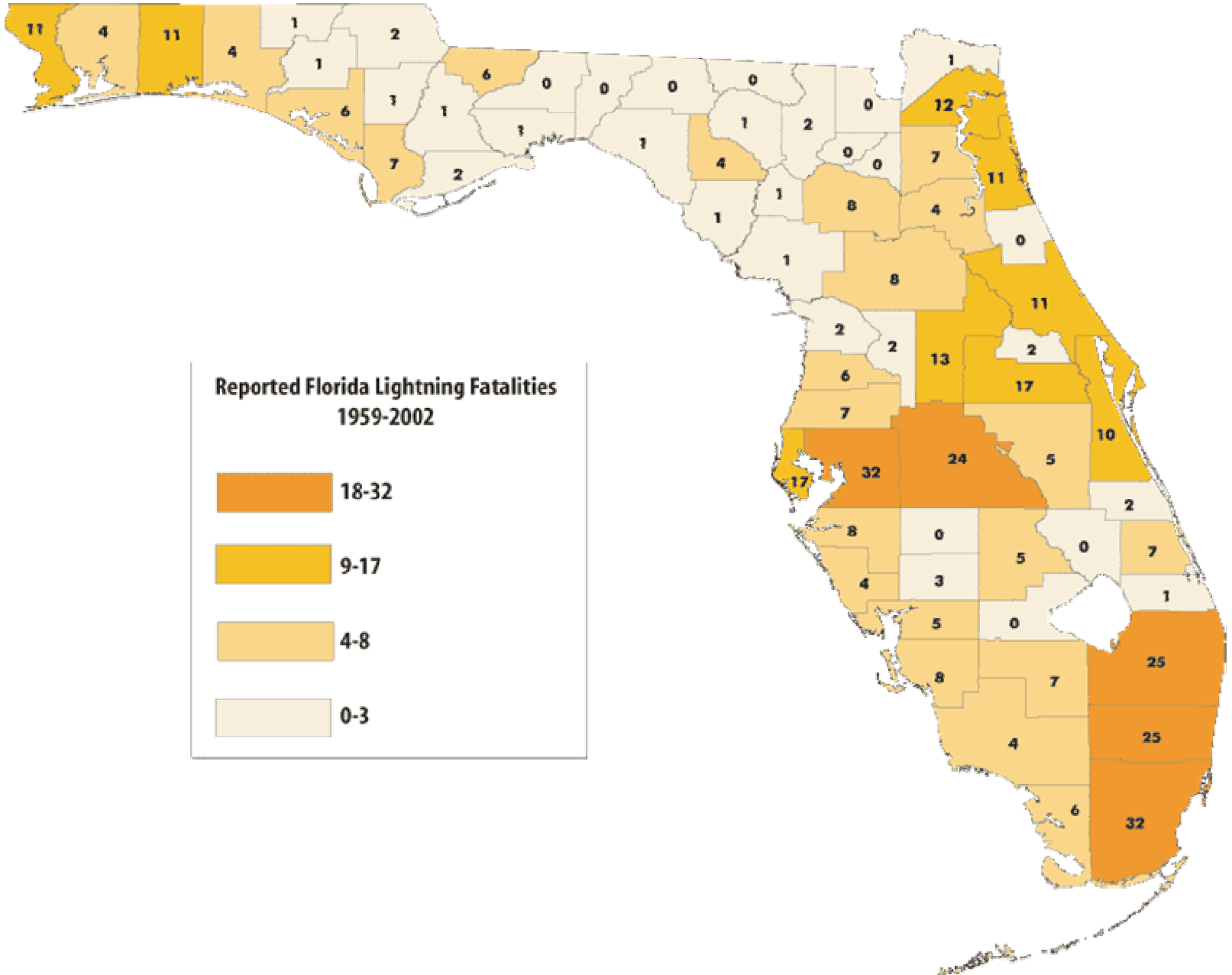
• AWIPS NLDN & SCAN (lightning trend tables)

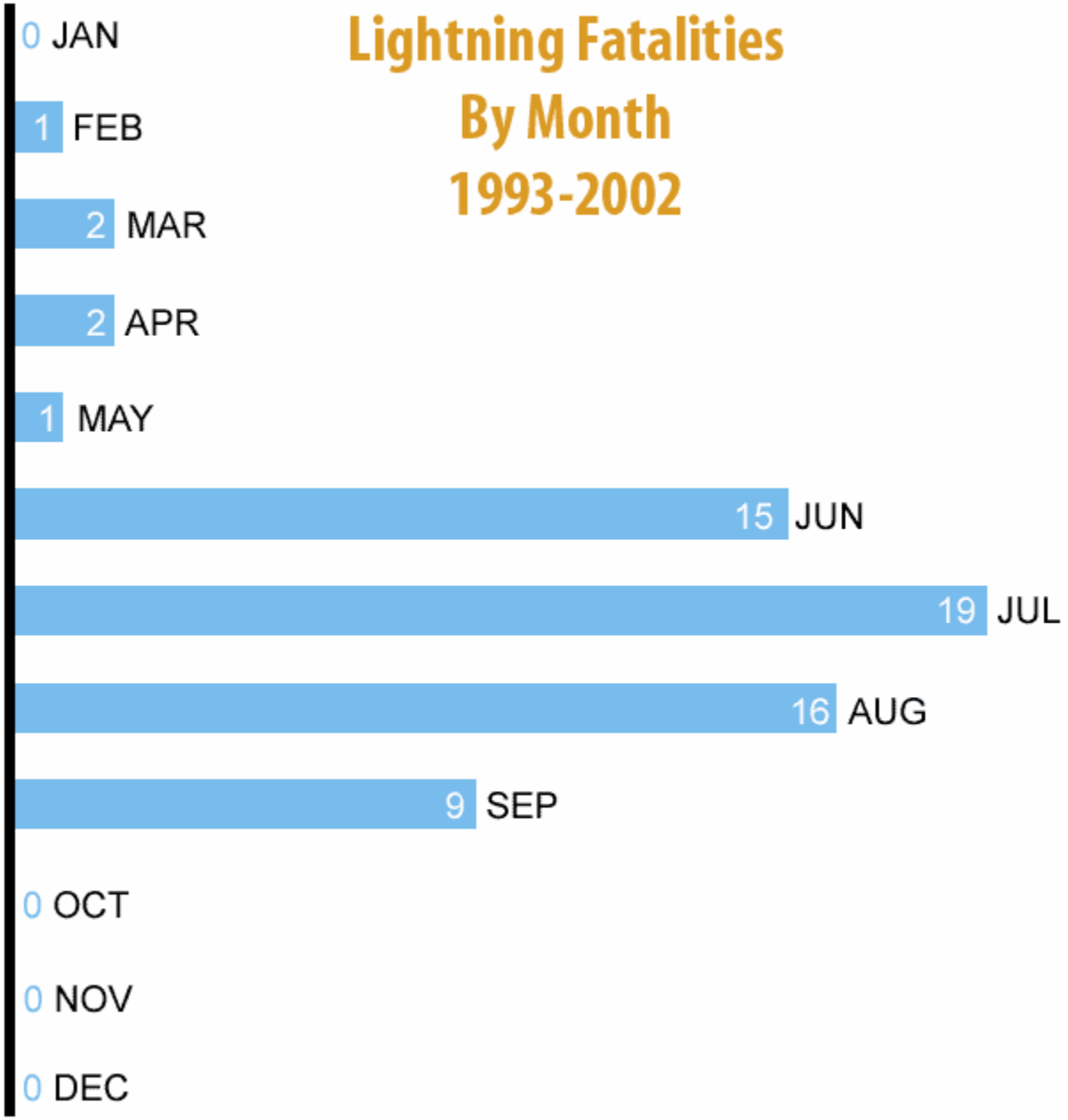


Lightning Detection And Ranging (LDAR)

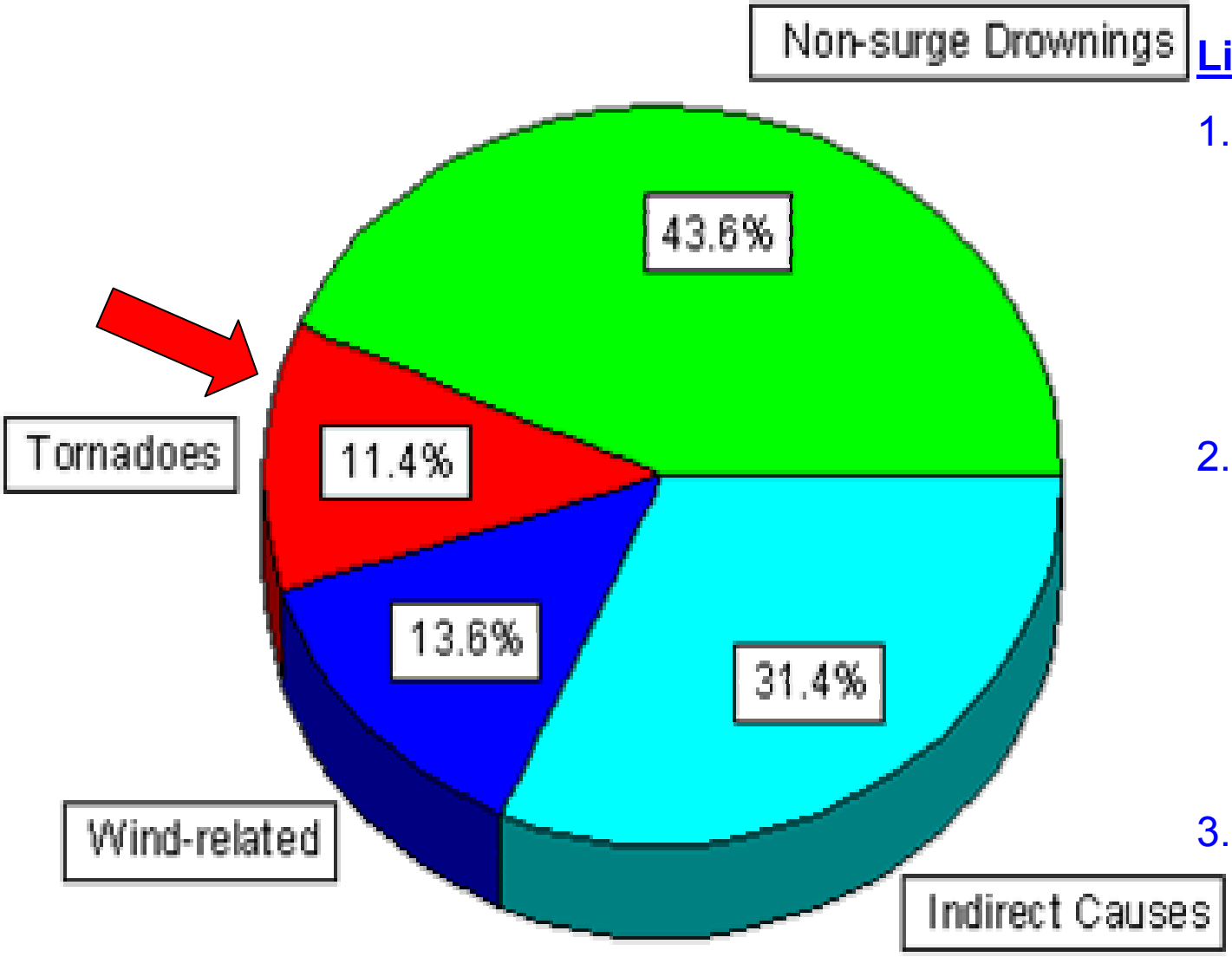


421 Lightning Deaths 1633 Lightning Injuries




Lightning Fatalities
By Month
1993-2002
0 JAN
1 FEB
2 MAR
2 APR
1 MAY
15 JUN
19 JUL
16 AUG
9 SEP
0 OCT
0 NOV
0 DEC

Florida Tropical/Sub-Tropical Cyclone Deaths (1957-1996)



Lightning TC Deaths

1. 29 August 1968 ***Lightning*** killed 2 Army Rangers and injured 7 others at Eglin AFB (Tropical Disturbance nearby)
2. 1 October 1969 ***Lightning*** killed a construction worker on a bridge in Orange Park (Sub-Tropical Storm nearby)
3. 30 August 1992 ***Lightning*** killed a man who was unloading relief supplies for Hurricane Andrew

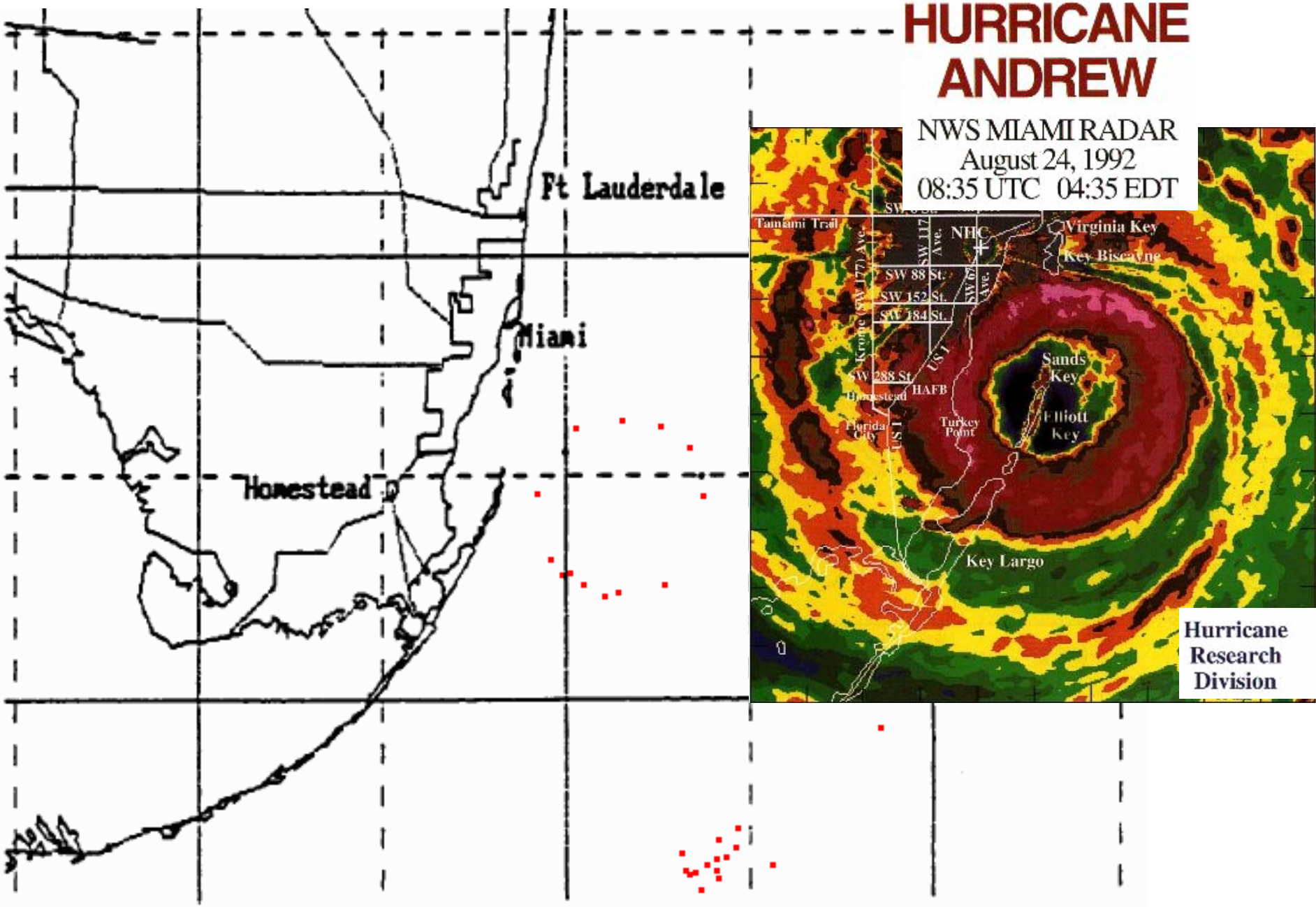
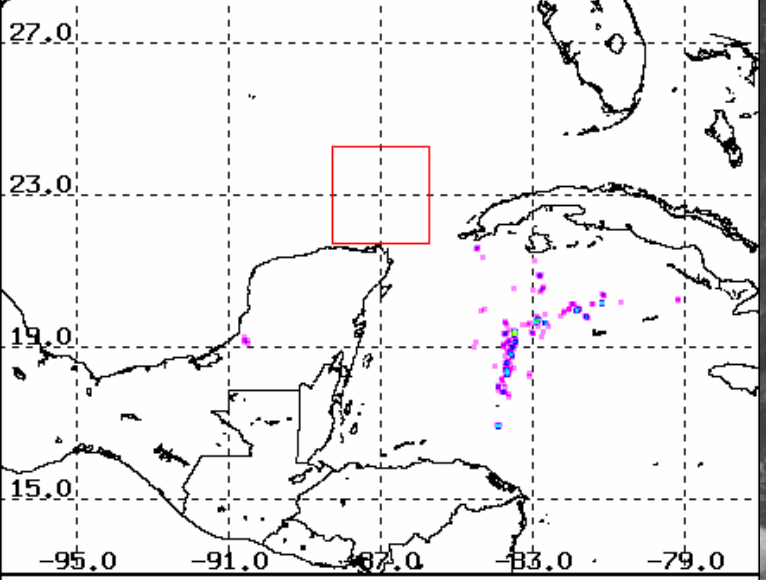
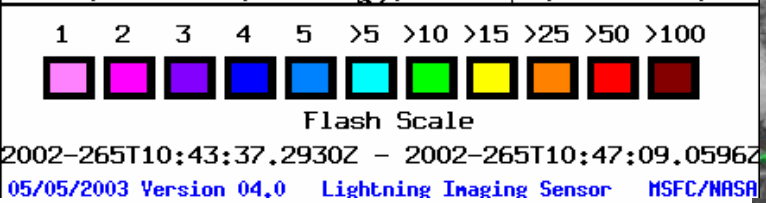
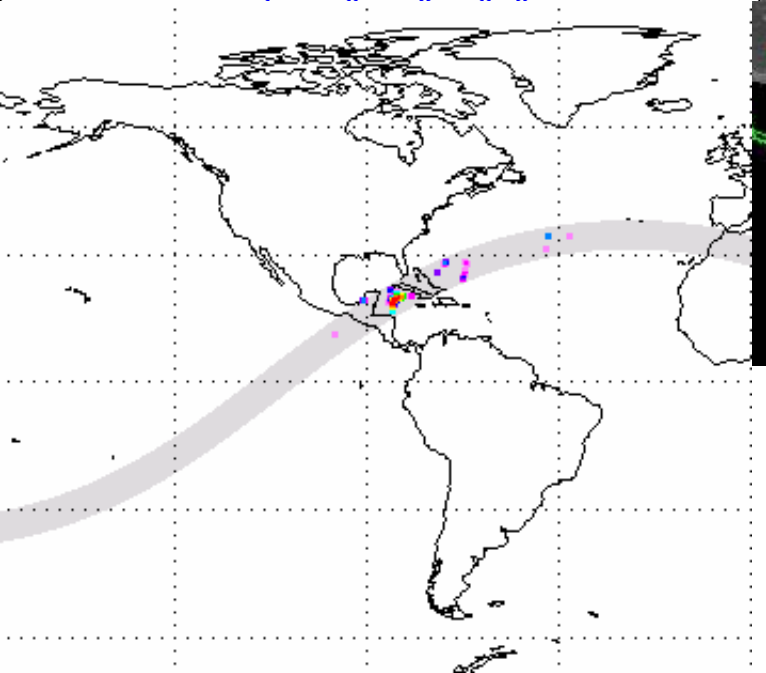
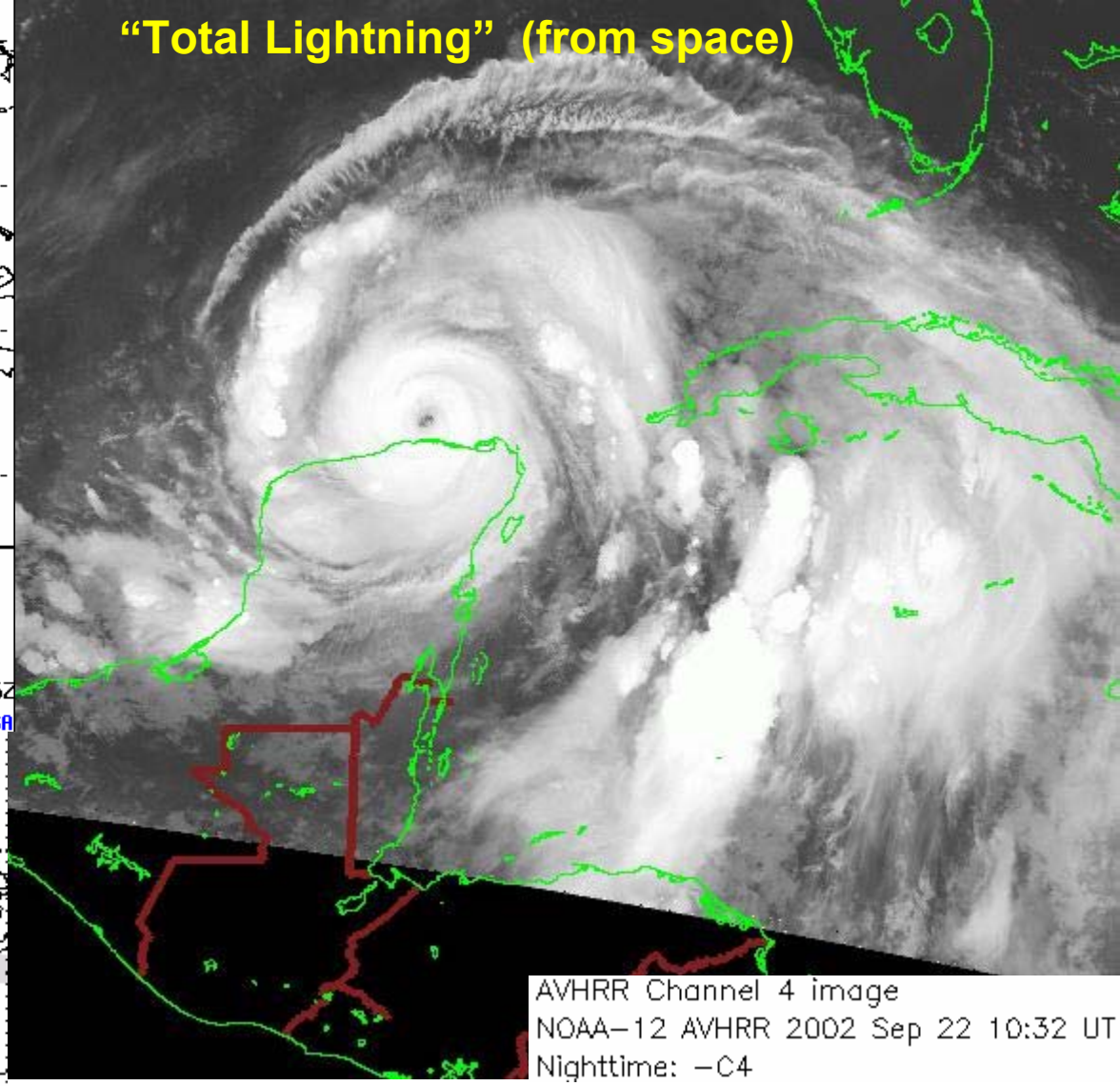


Figure 1. 10 minute composite of cloud-to-water lightning strokes ending at 0743 UCT 24 AUG 1992.









Hurricane Isidore (2002)

at max intensity

110 knots, 934 mb

OBSERVED RELATIONSHIPS BETWEEN TOTAL LIGHTNING INFORMATION AND DOPPLER RADAR DATA DURING TWO RECENT TROPICAL CYCLONE TORNADO EVENTS IN FLORIDA

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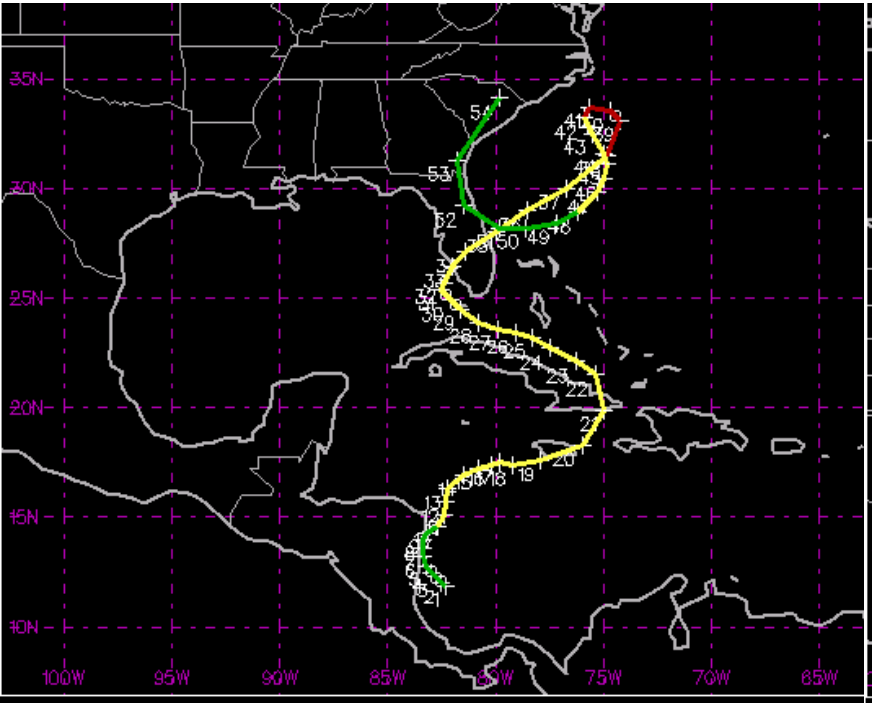
"hypothesis"

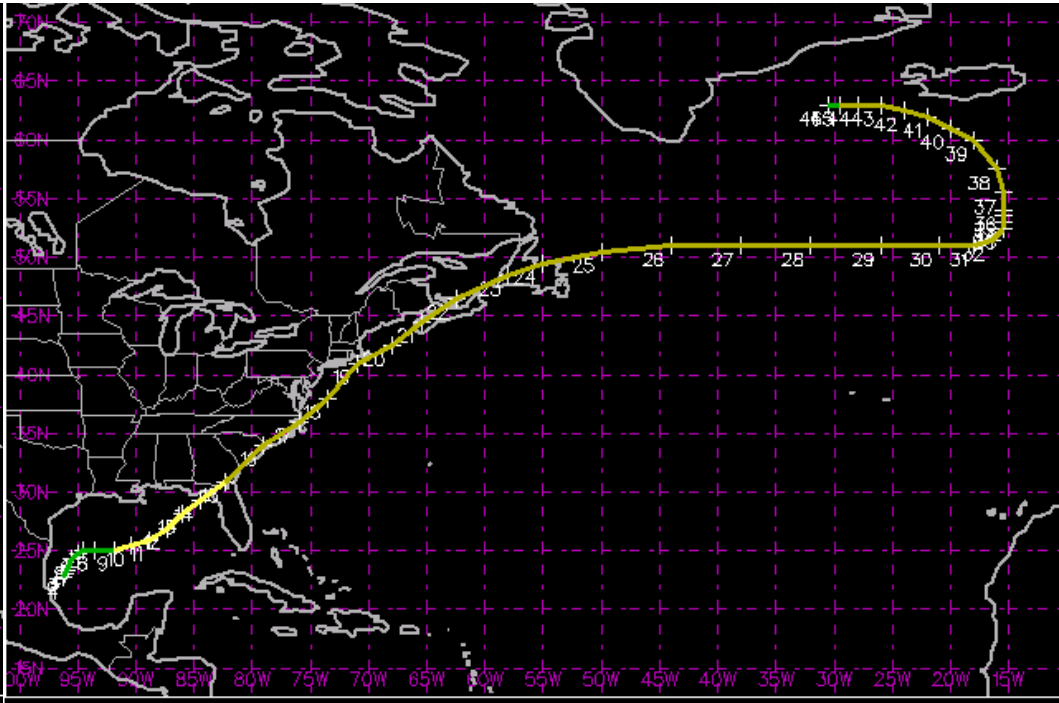
1. INTRODUCTION

The presence of a unique *(total)* lightning detection network and a nearby WSR-88D radar within east central Florida has afforded many opportunities to investigate the structure and life cycle of convective cells in great detail. Until now, these studies have focused on two main areas: the apparent relationships between excessive lightning and subsequent severe weather during "warm season" pulse storms (e.g. Hodanish et al., 1998) and the more dynamic storms of the "cool season" (e.g. Williams et al., 1998), and the identification of signatures prior to cloud to ground lightning initiation and cessation (Forbes et al., 1996).

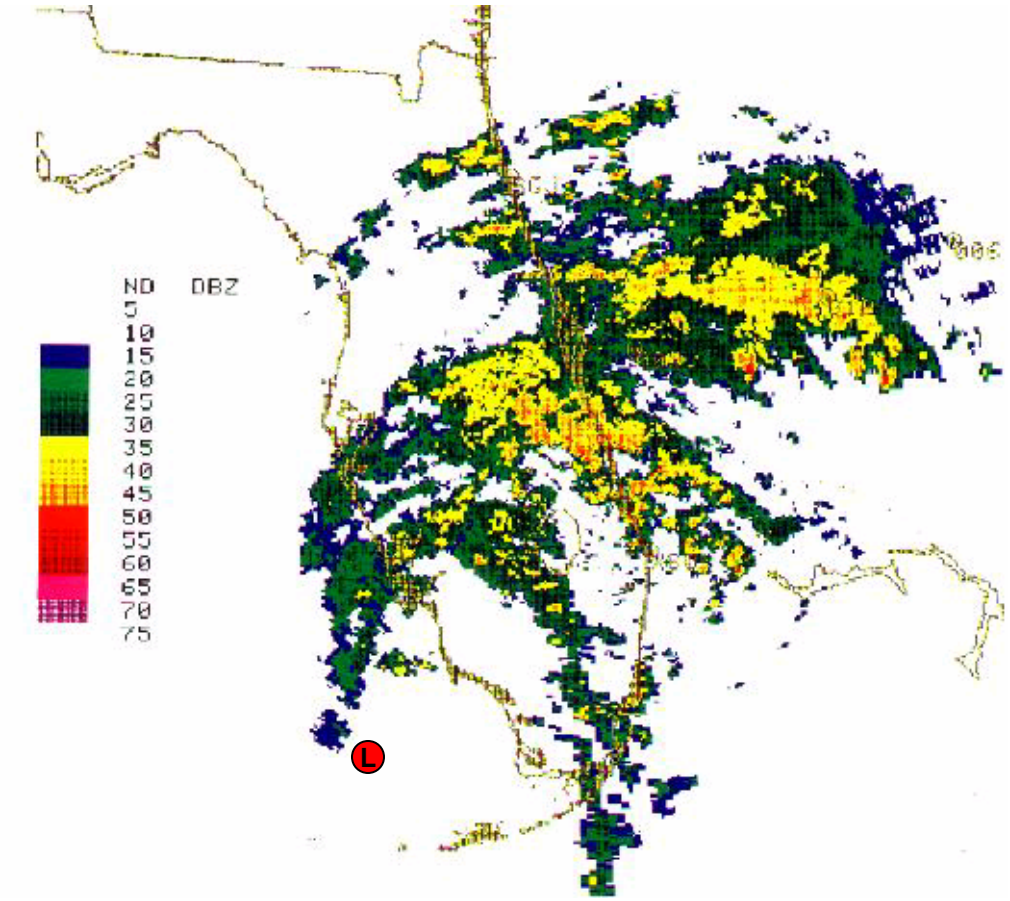
TS Gordon (1994)



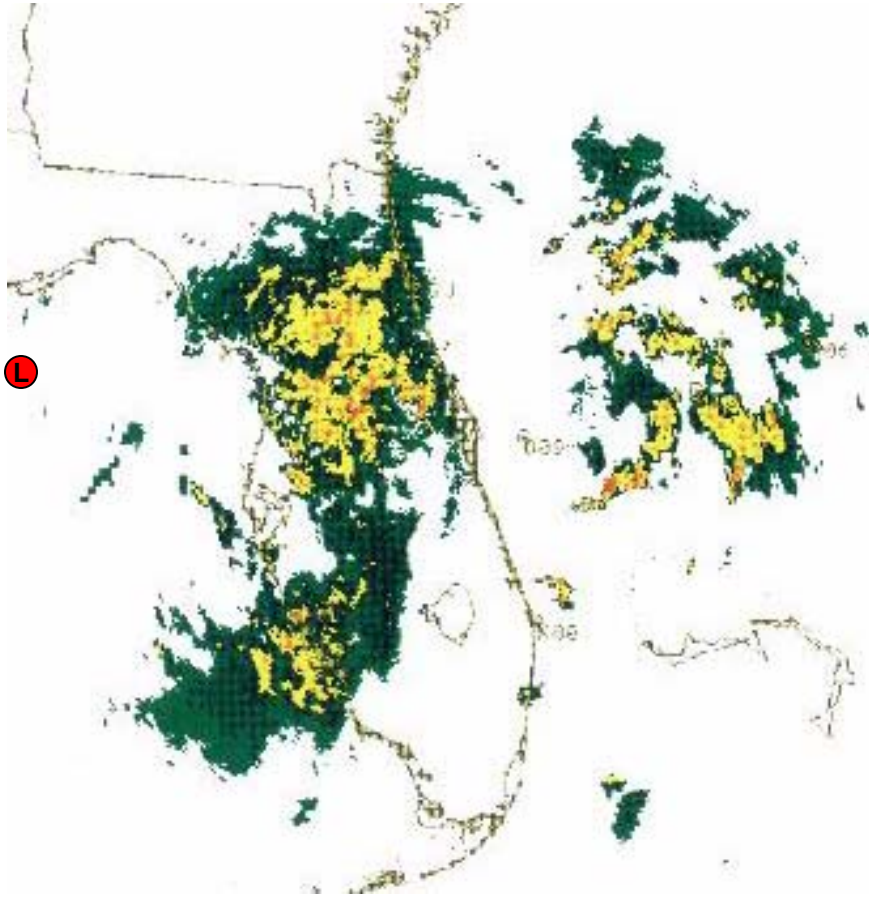
TS Josephine (Oct. 1996)



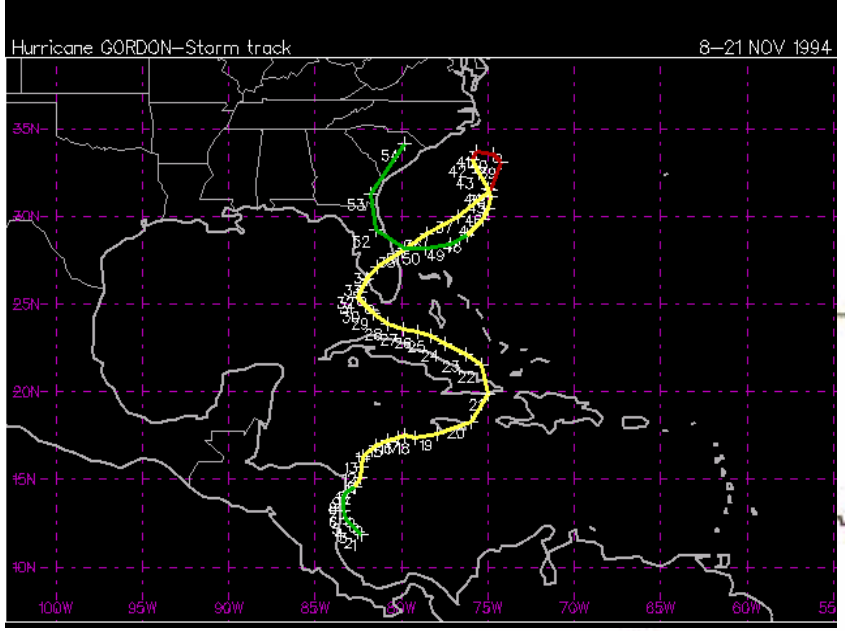
TS Gordon
(15 Nov 1994 2300 UTC)

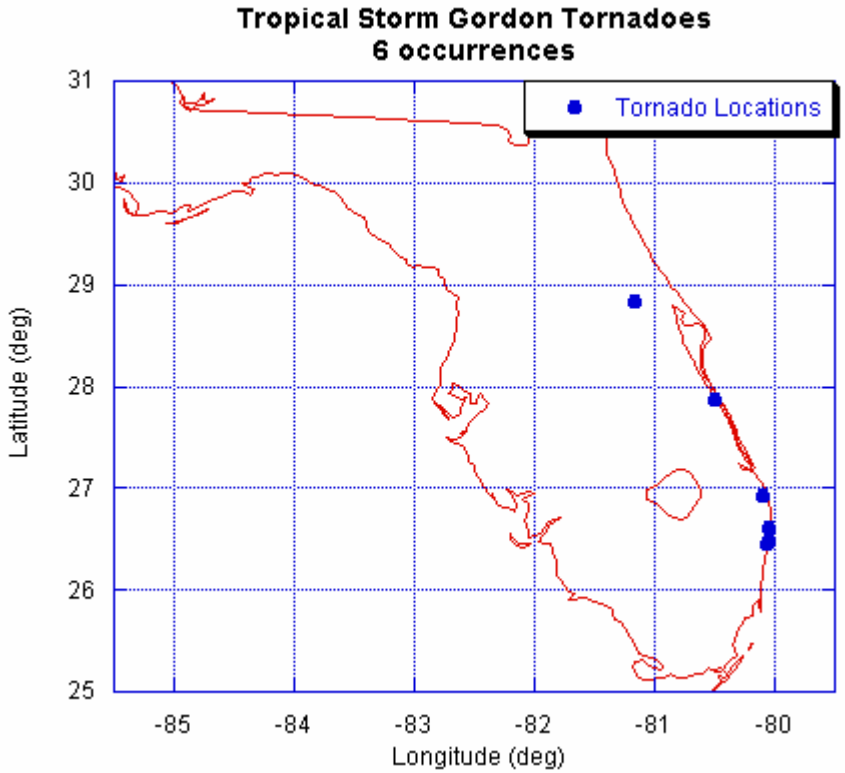


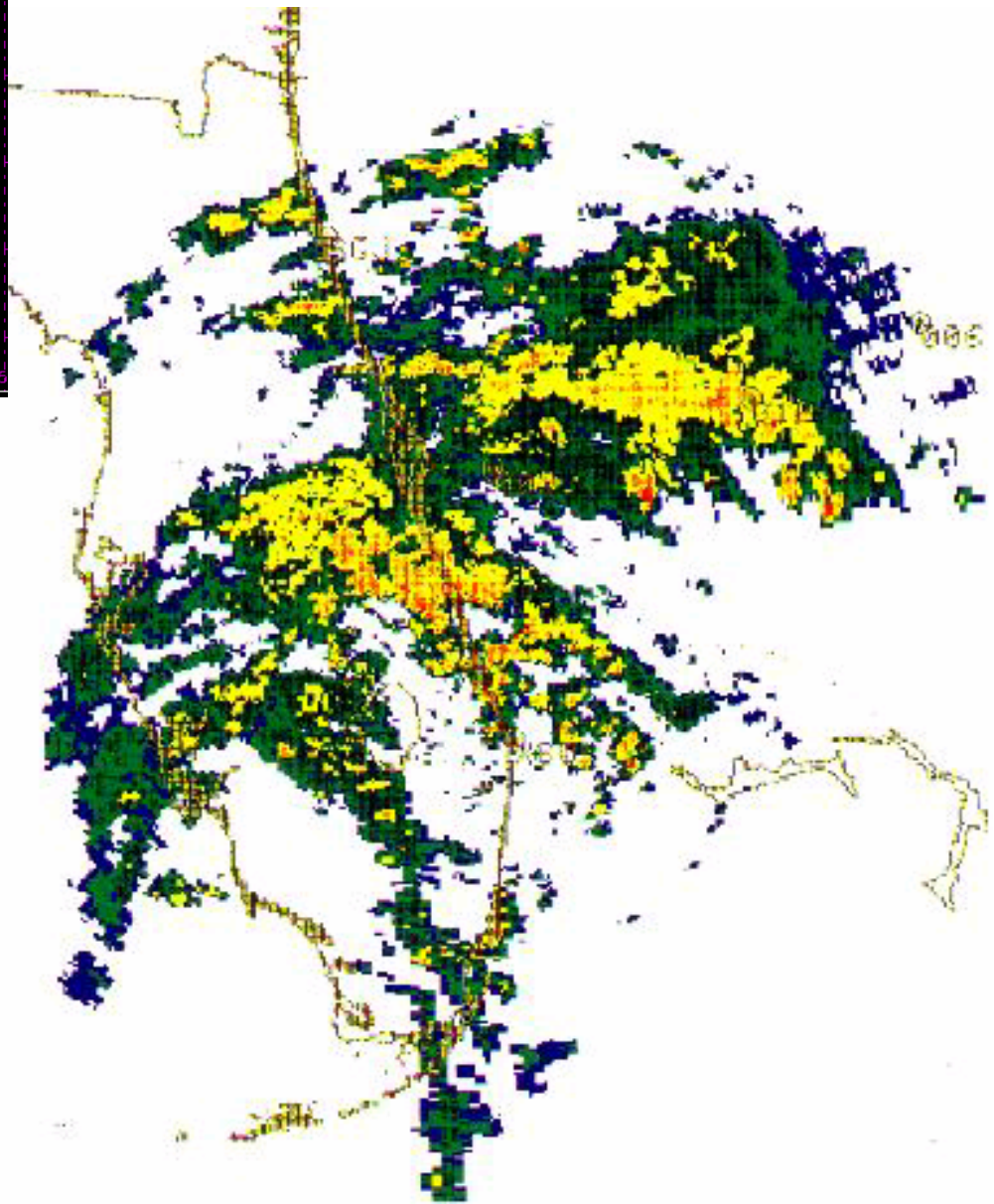
TS Josephine
(7 Oct 1996 2039 UTC)



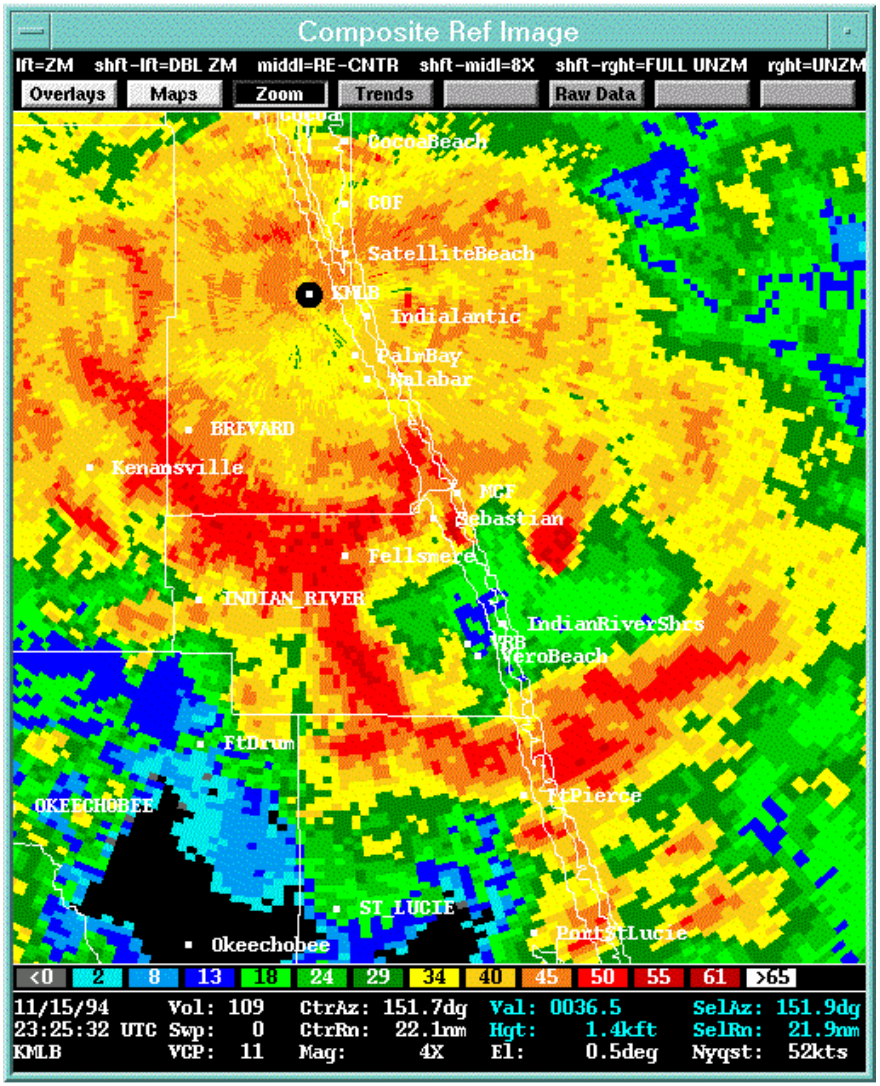
Tropical Storm Gordon
November 15, 1994

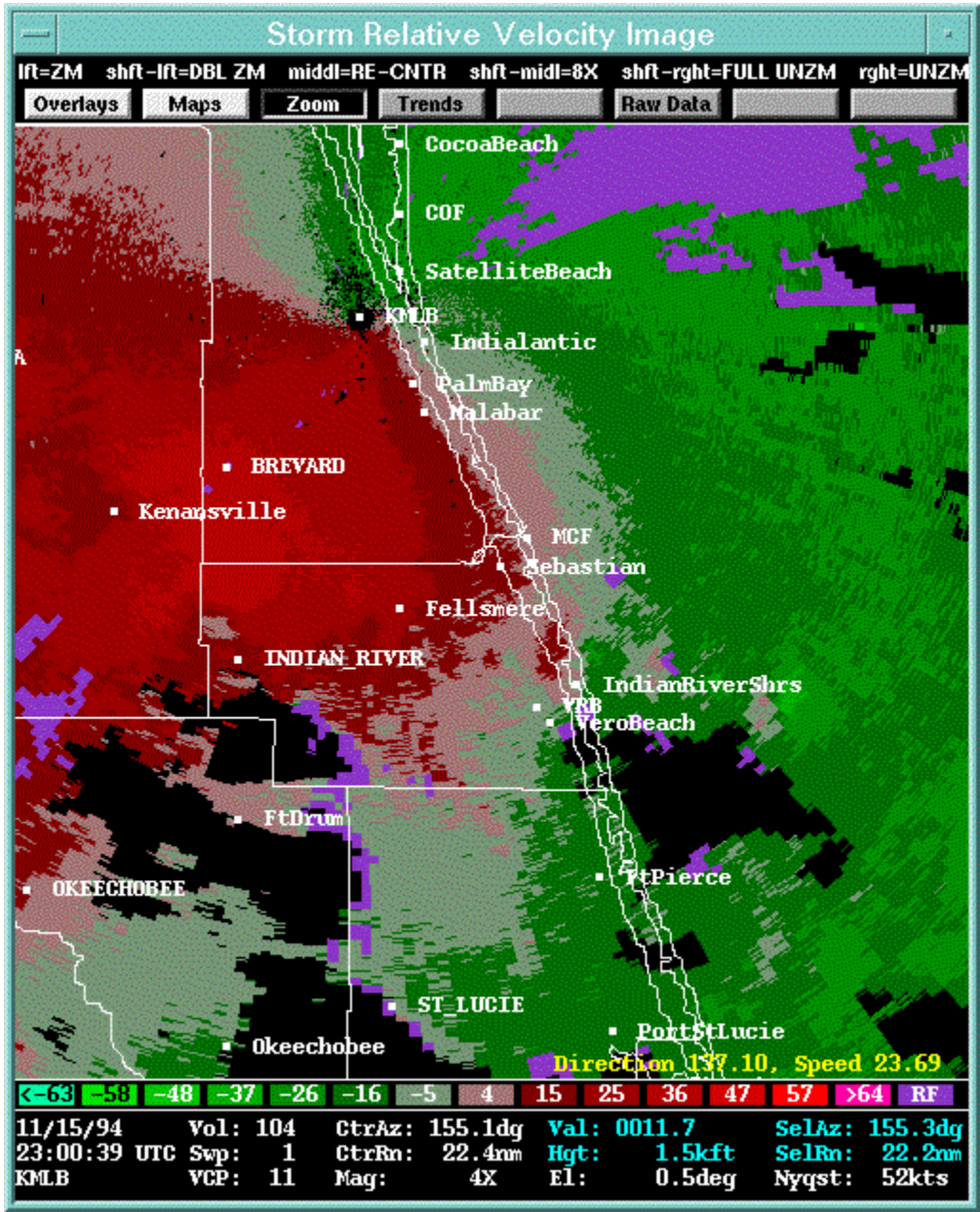






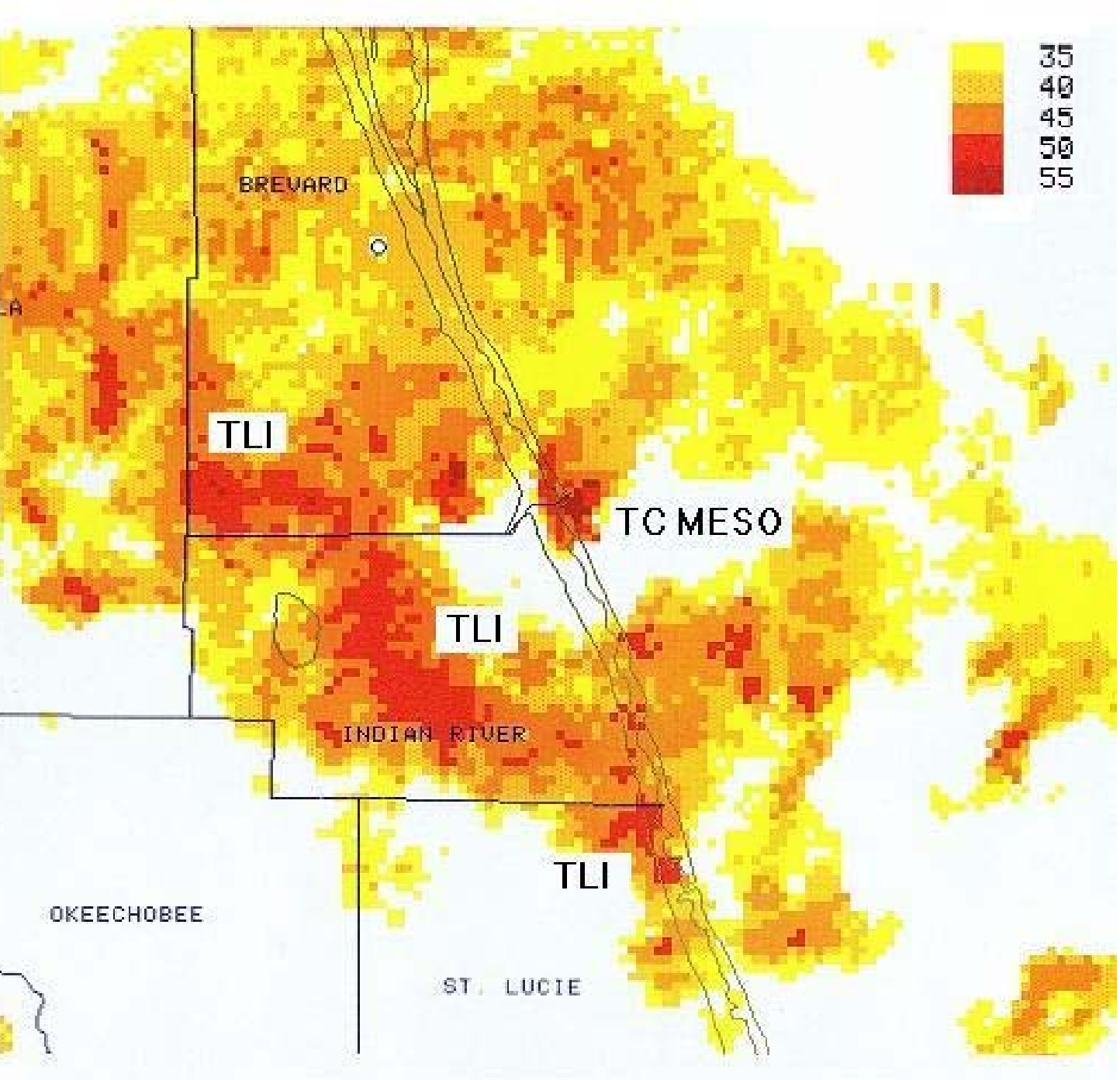
Tropical Storm Gordon (1994) Mini Supercells





Tropical Storm Gordon (1994)

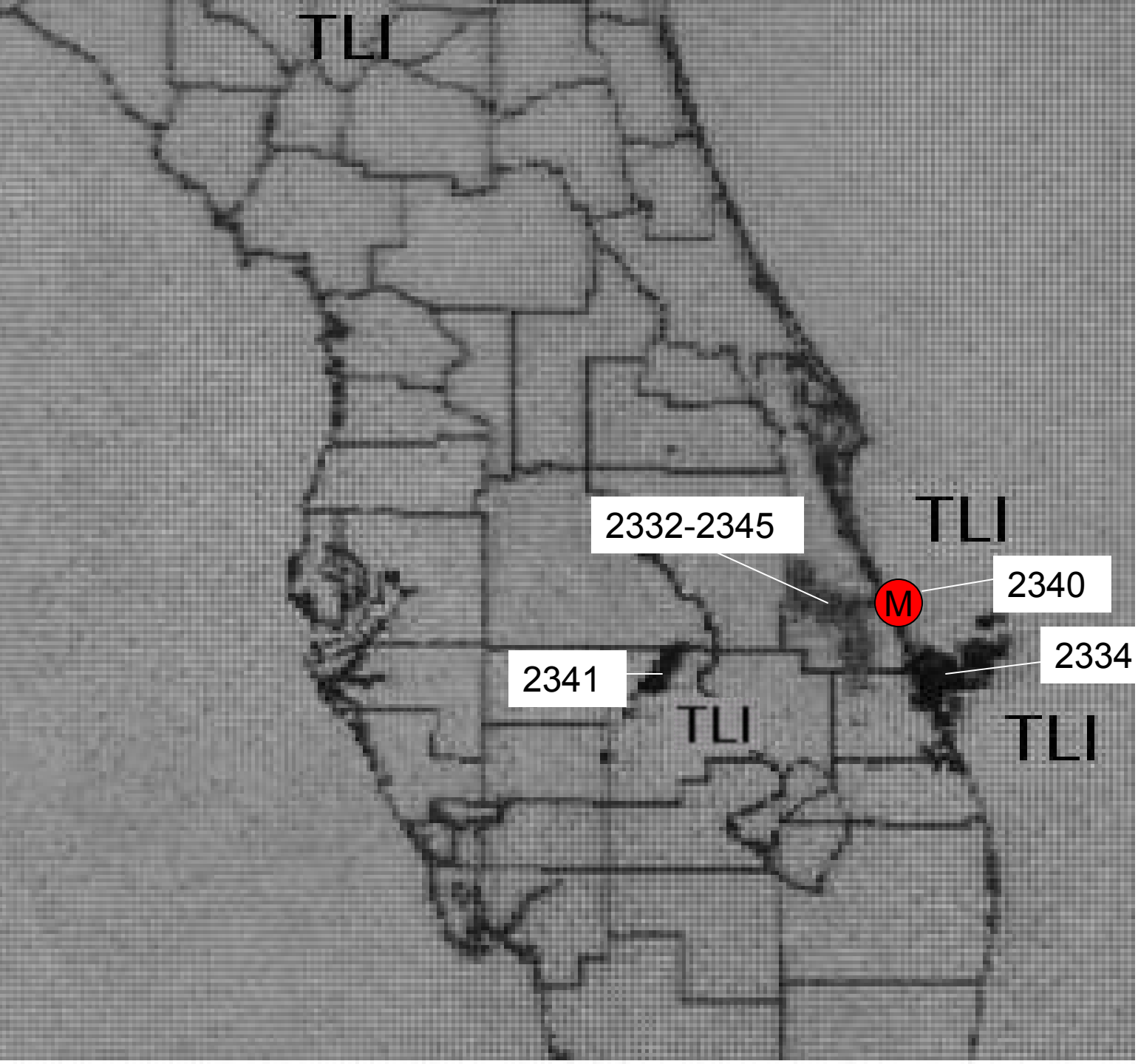
Tornadic Mesocyclone



Meso spawned F2 tornado @ 2353 UTC

2340 UTC

KMLB CR

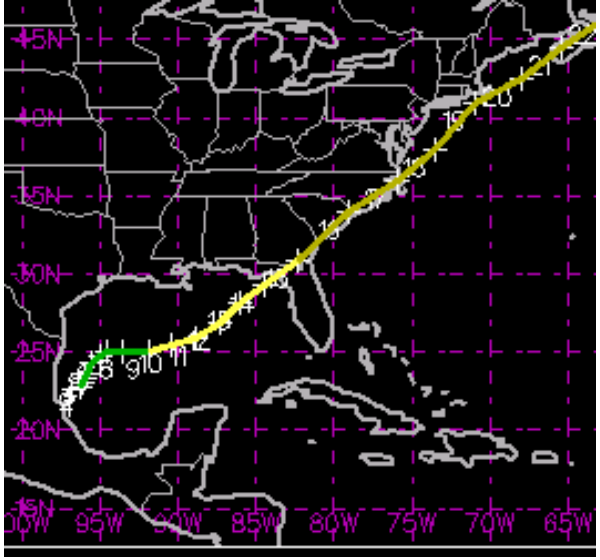


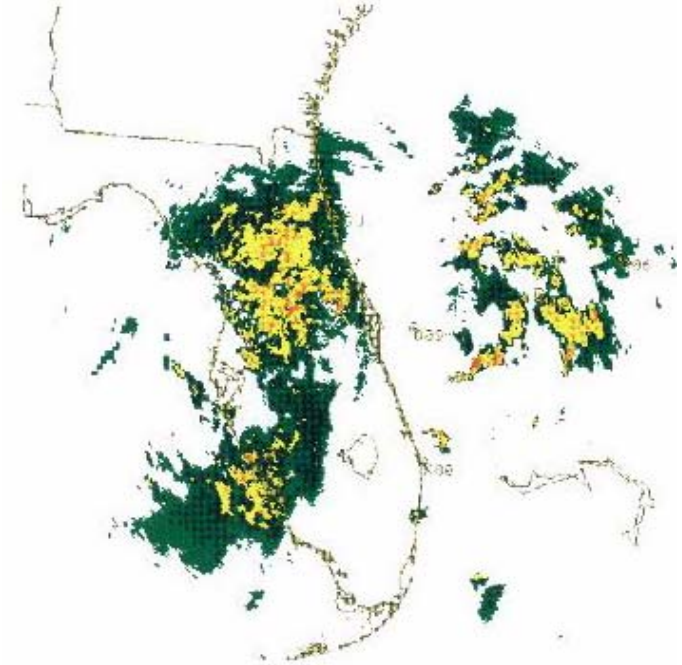
Tropical Storm Gordon (1994)

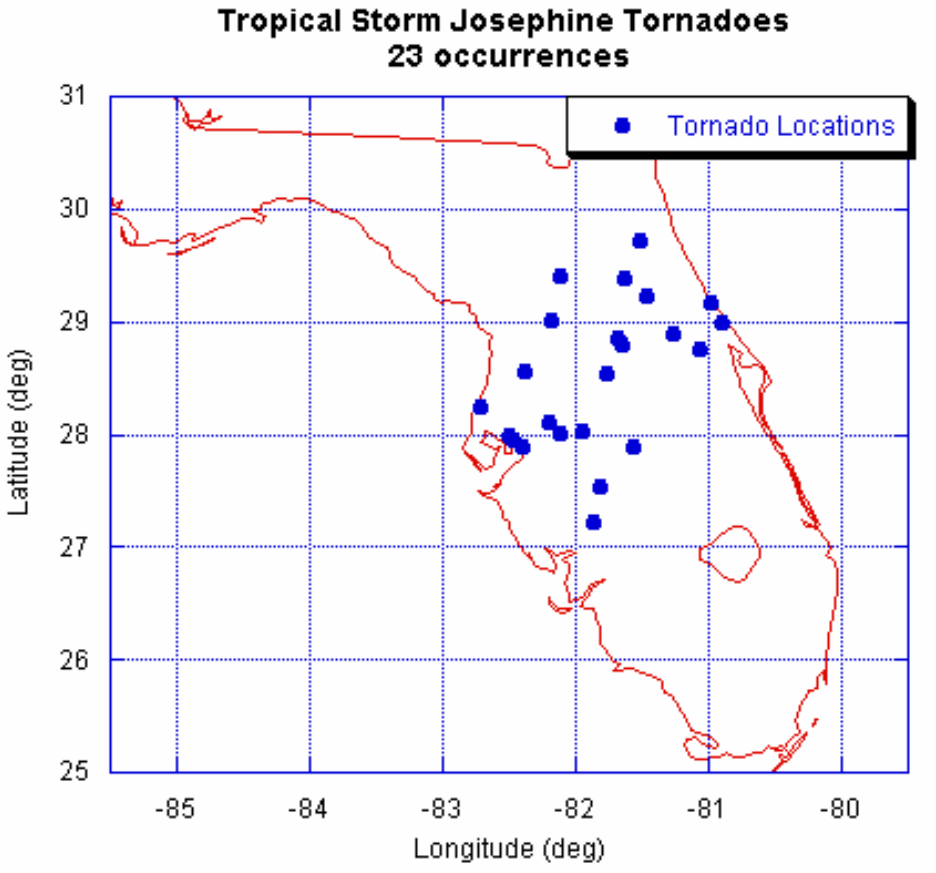
Total Lightning Information (TLI)

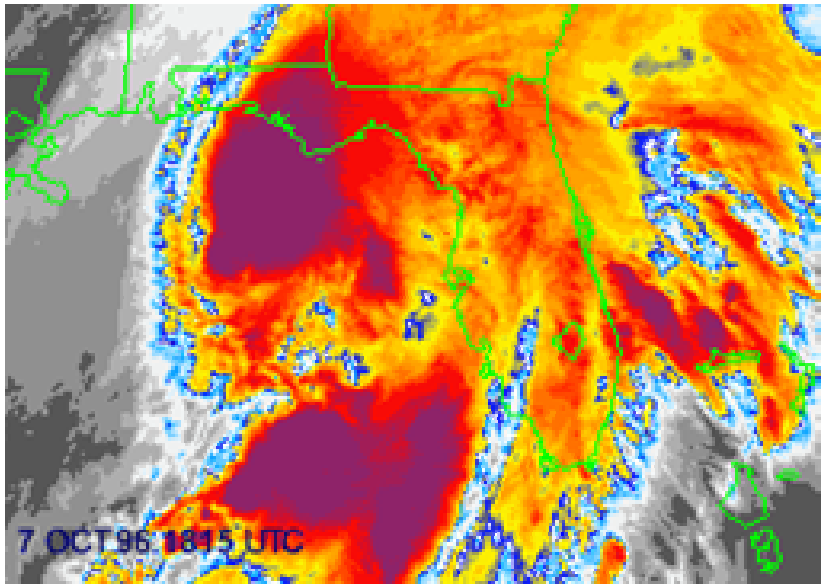
2330-2359 UTC

Tropical Storm Josephine
October 7, 1996

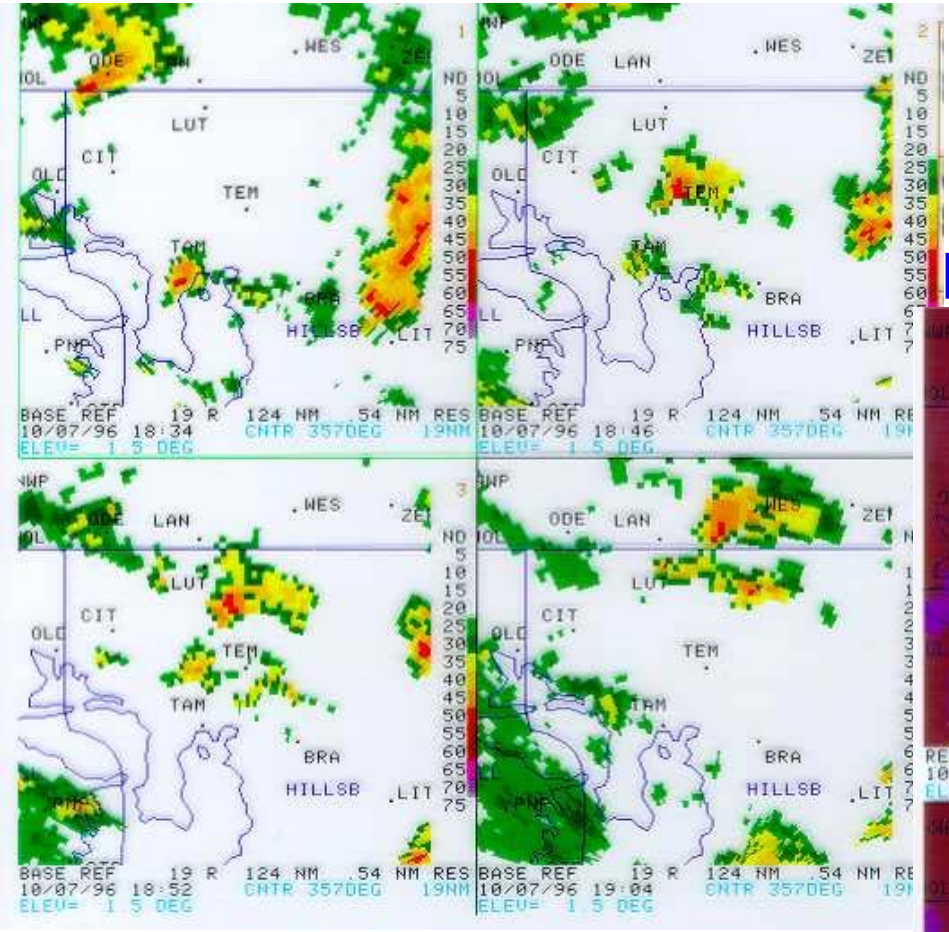




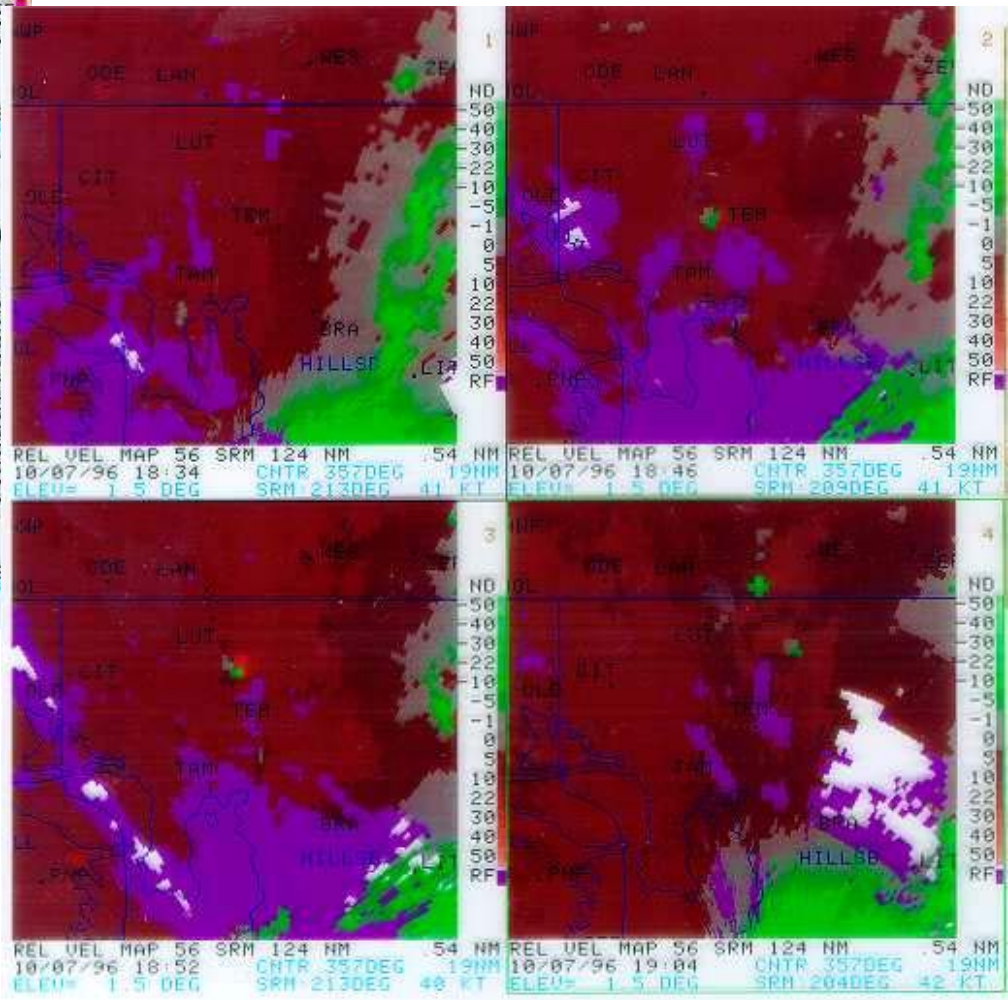




KTBW 1.5 R 1834-1904 UTC

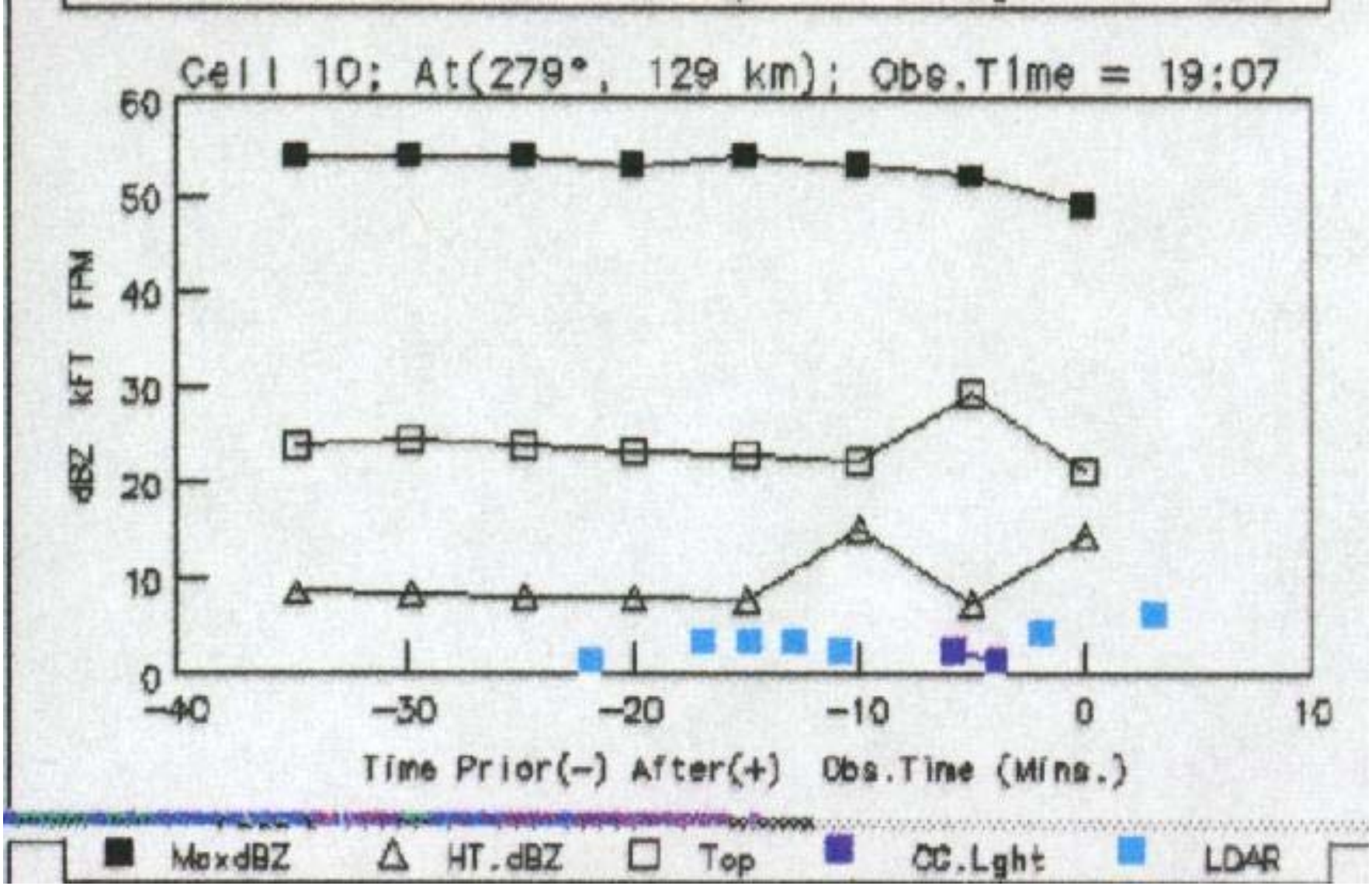


KTBW 1.5 SRM 1834-1904 UTC



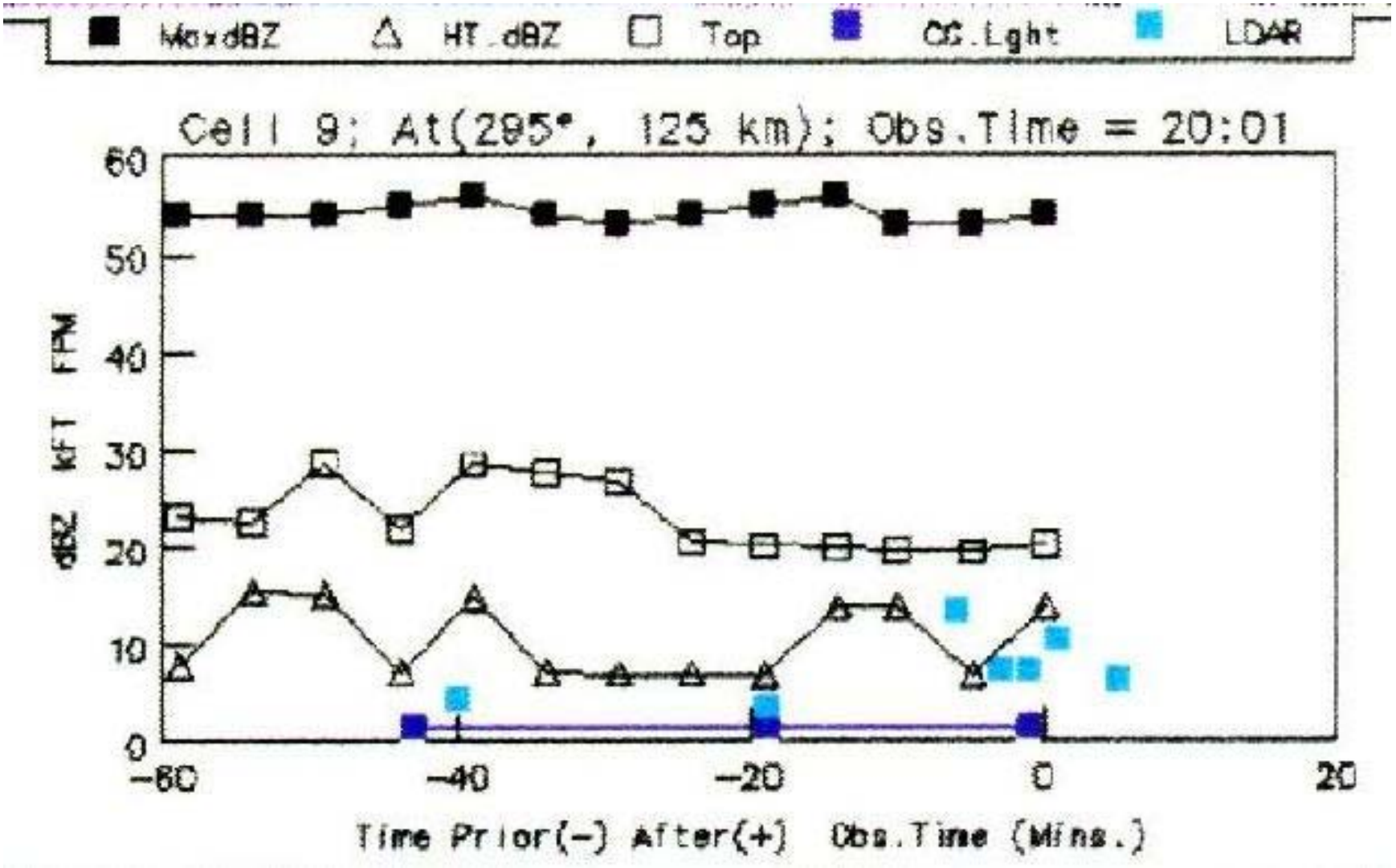
1840 UTC Shear = .011 s^{-1}

1852 UTC Shear = .018 s^{-1}



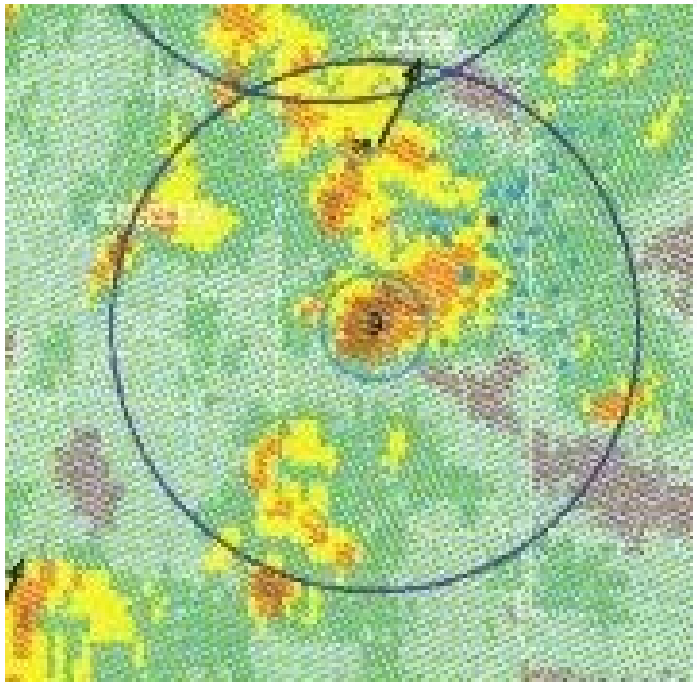
Hillsborough County Tornado 1845-1900 UTC

(-22 to -7 LISDAD time)

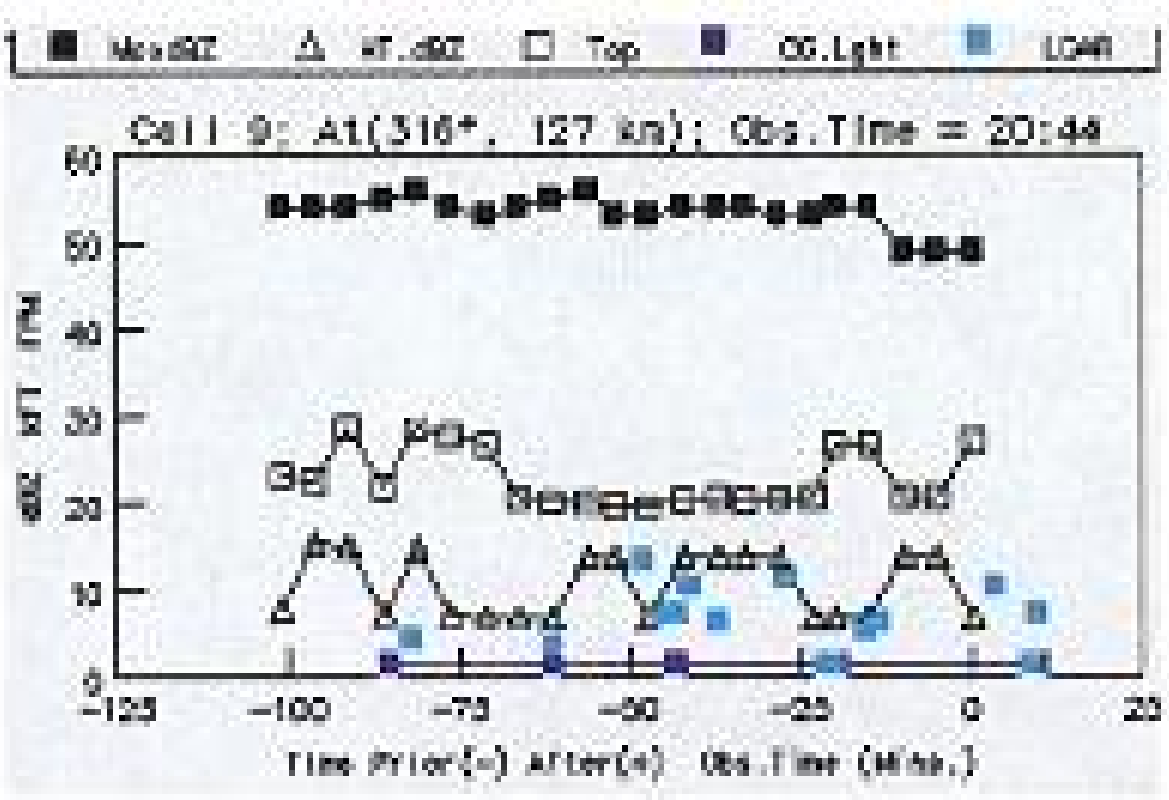


Lakeland Tornado 1906 -1920 UTC

(-55 to -41 LISDAD time)



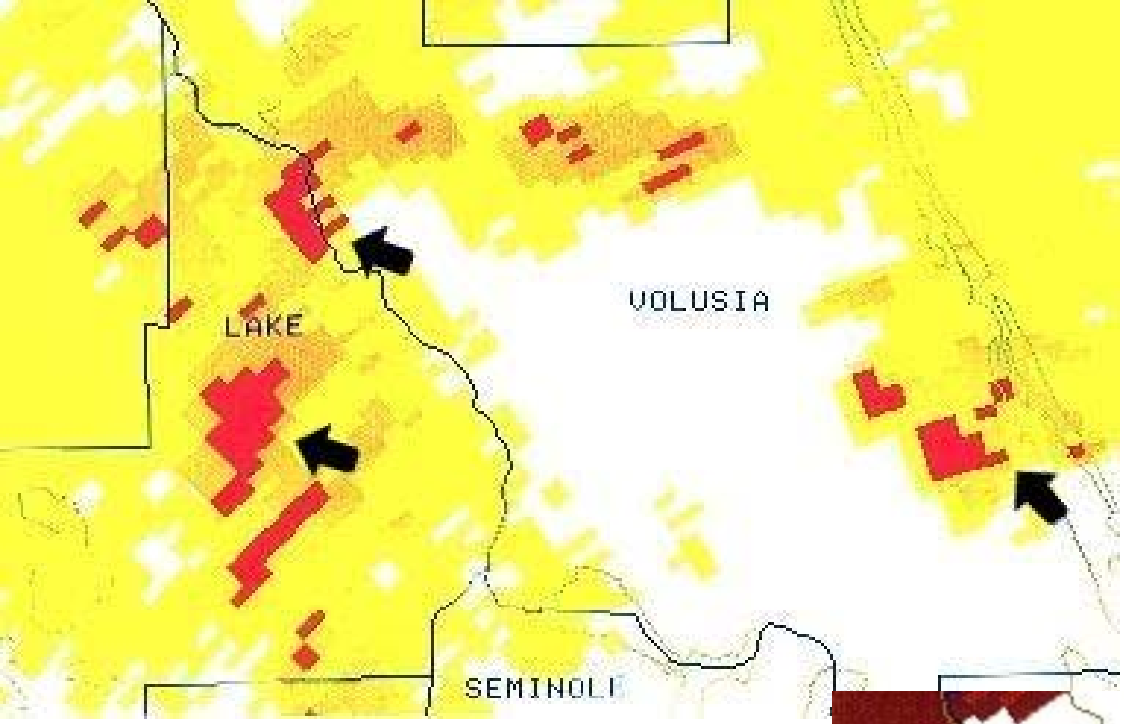
1957 UTC LISDAD
with TLI (1955-2000 UTC)
-47 LISDAD time



Time 0 = 2044 UTC; Time -100 = 1904 UTC

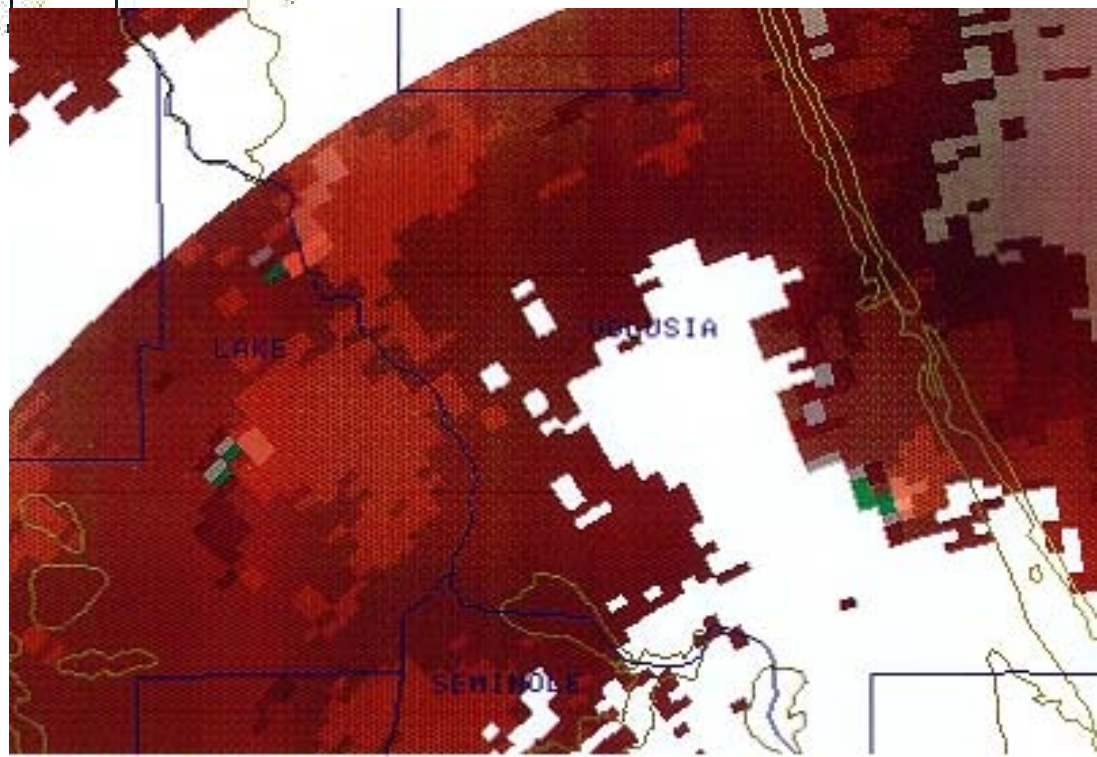
F0 Tornadoes @ 2000, 2033, 2042 (also 1845-1920 & 2130Z)

-44, -11, -2 LISDAD time

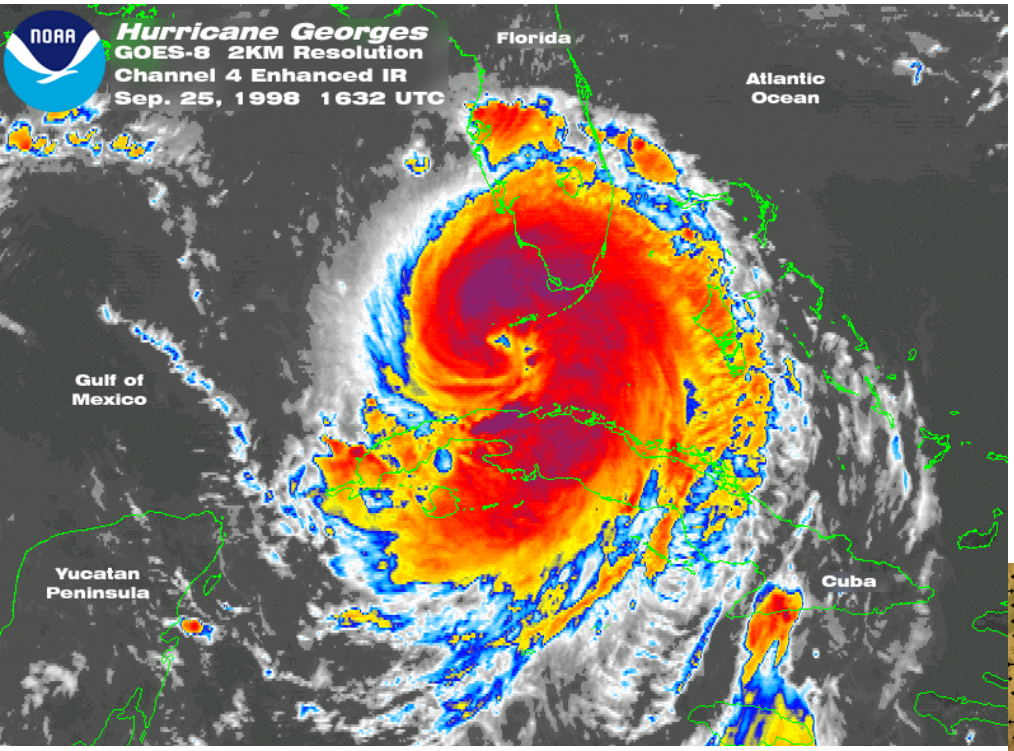


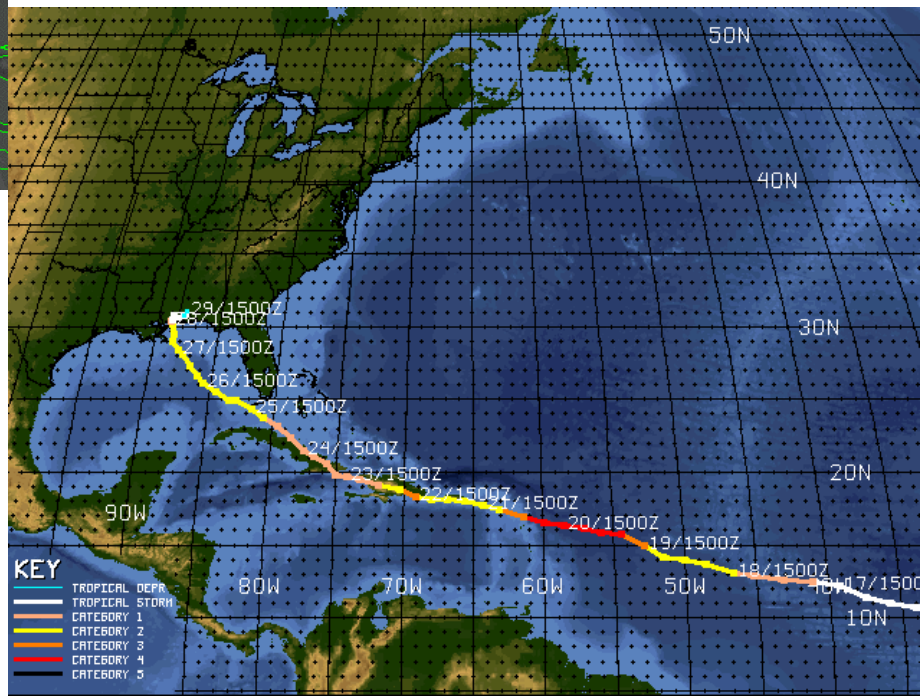
2120 UTC

2 F0's & 1 F2

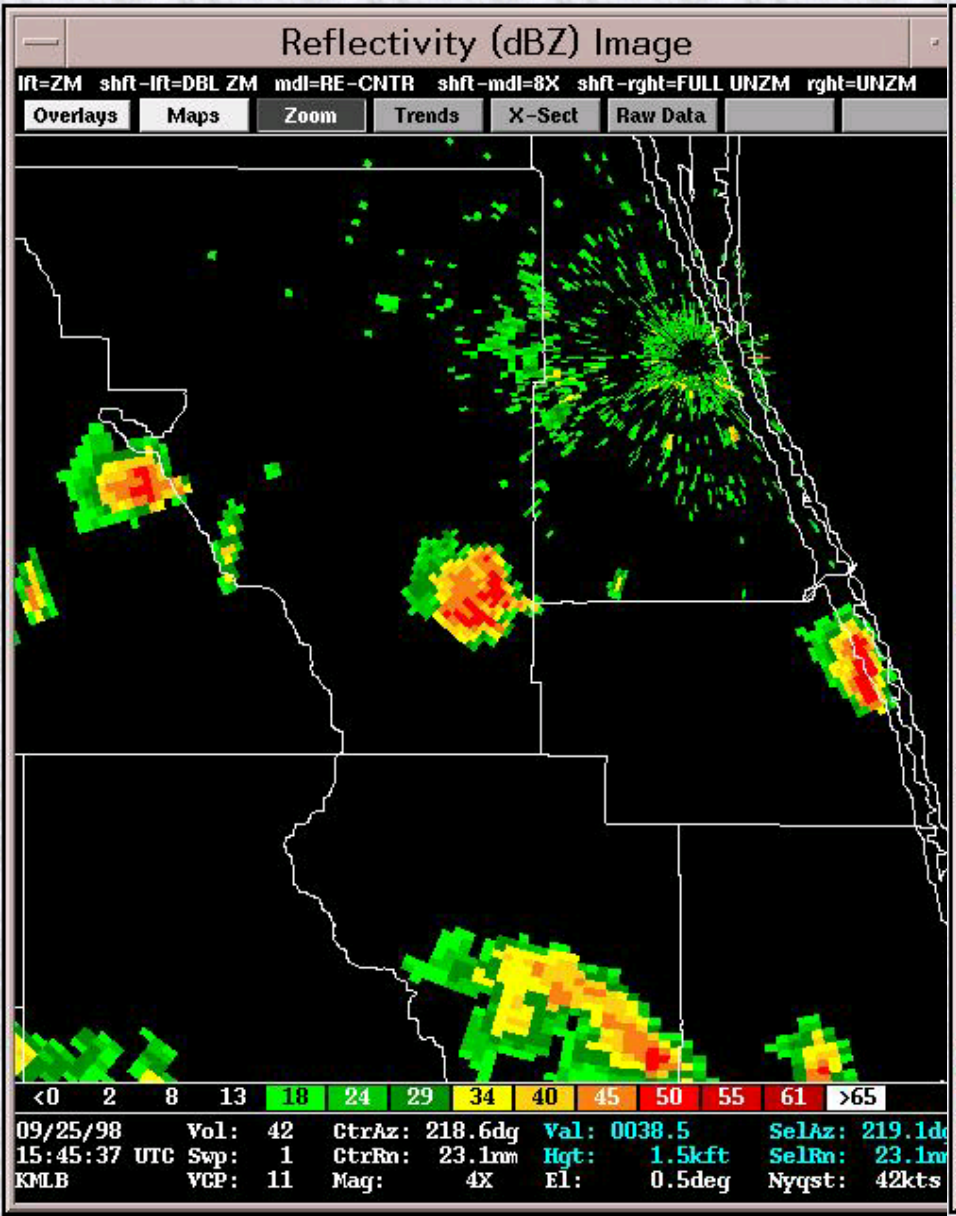


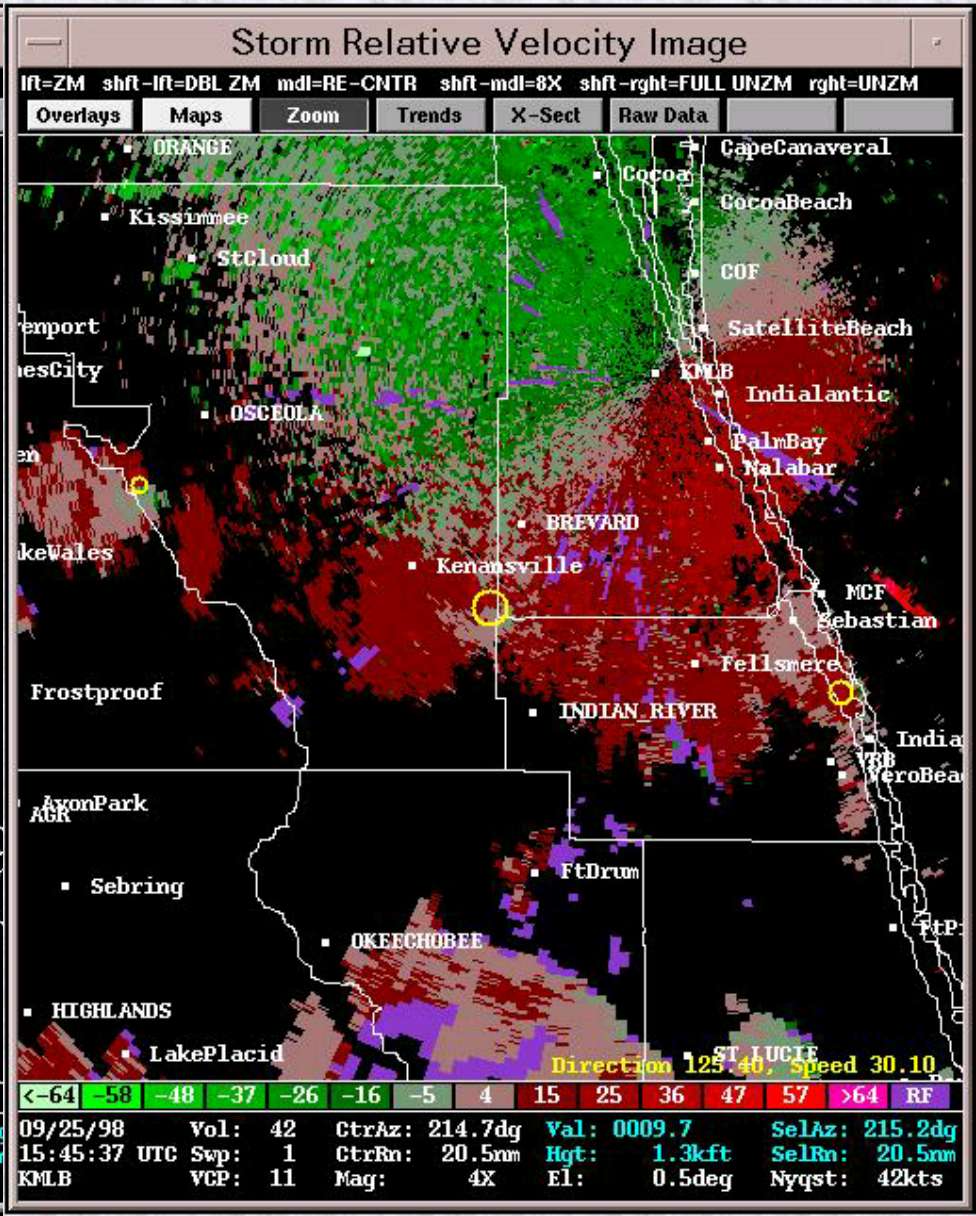
Hurricane Georges (1998)



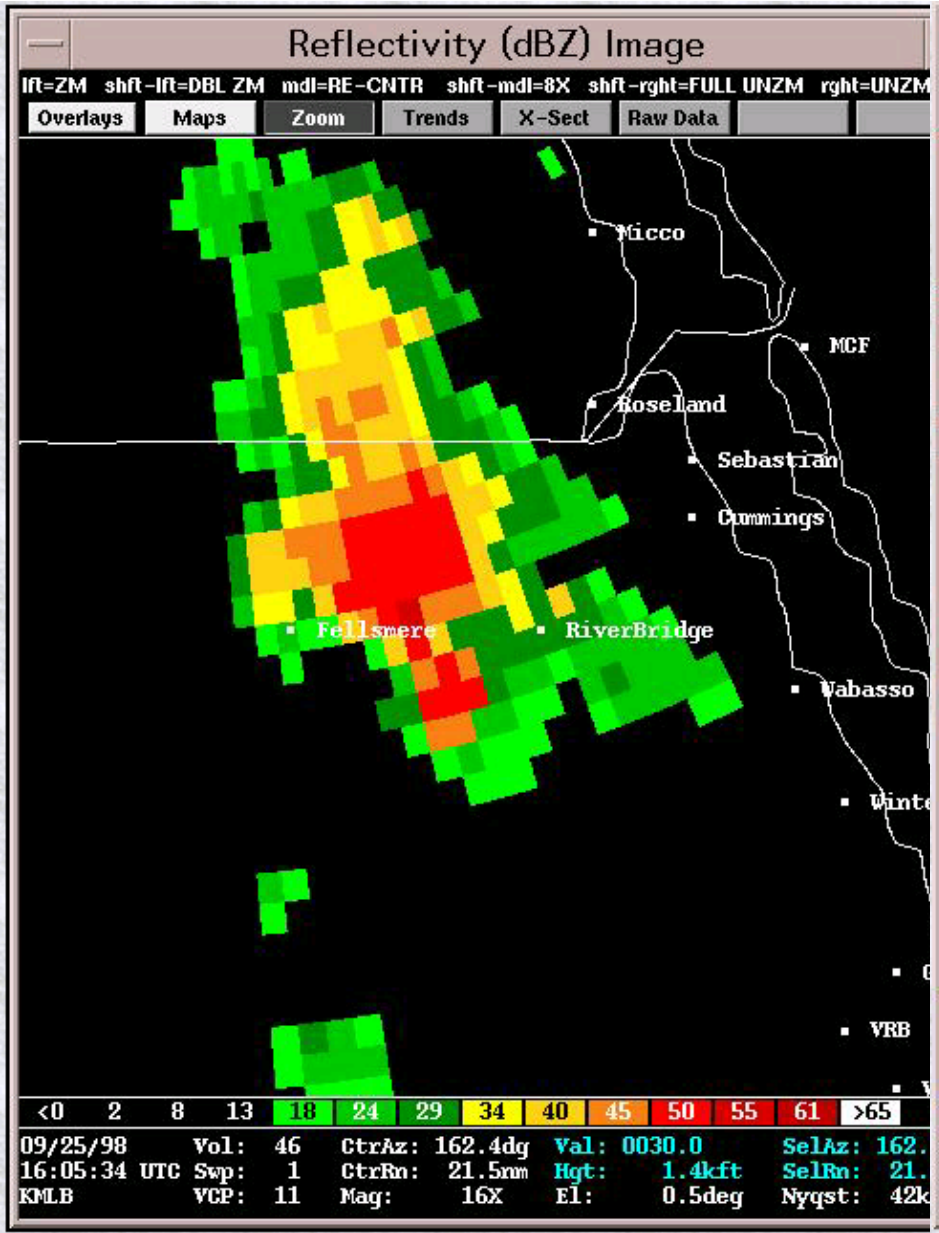


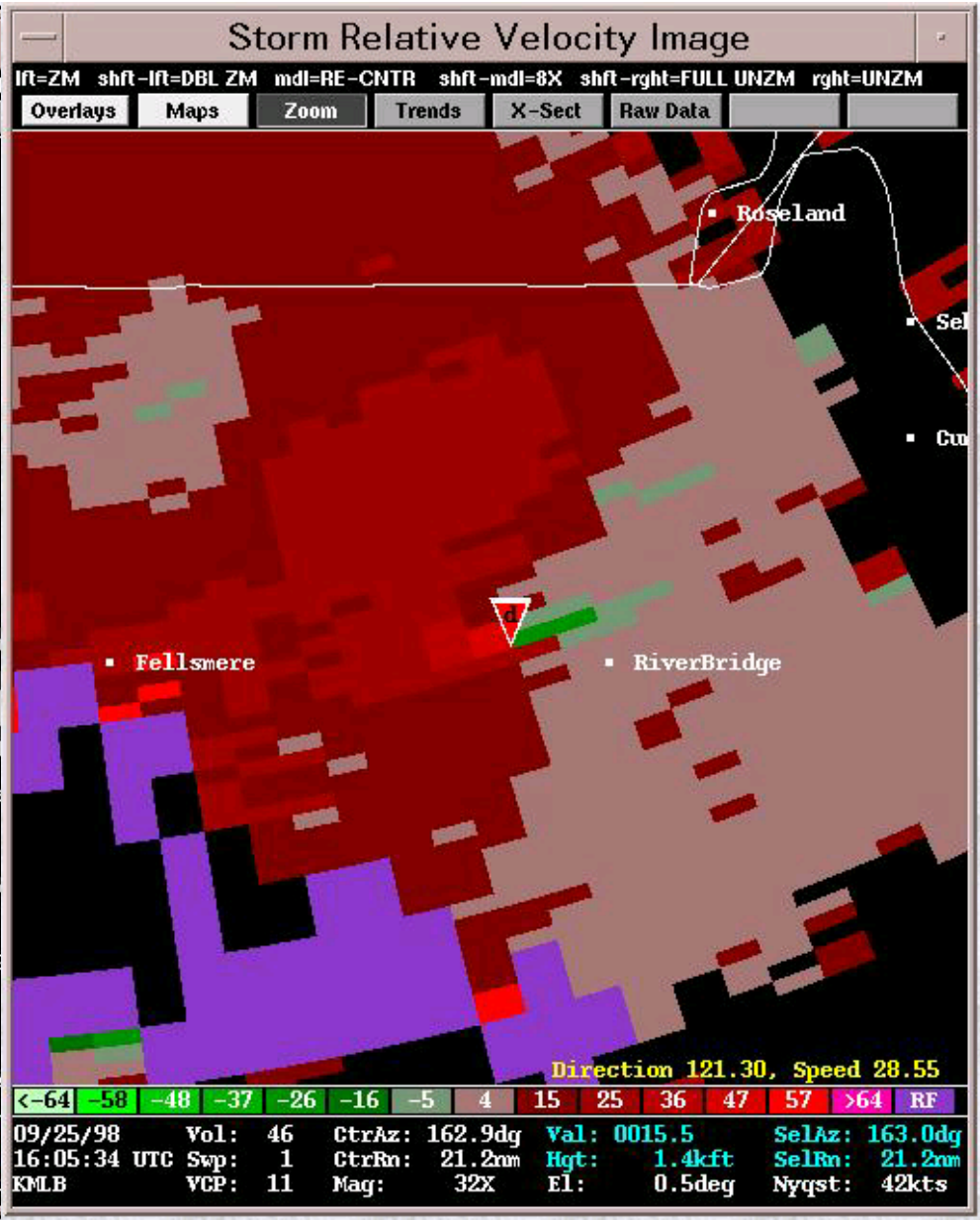
Hurricane Georges (1998) - Mini-Supercells

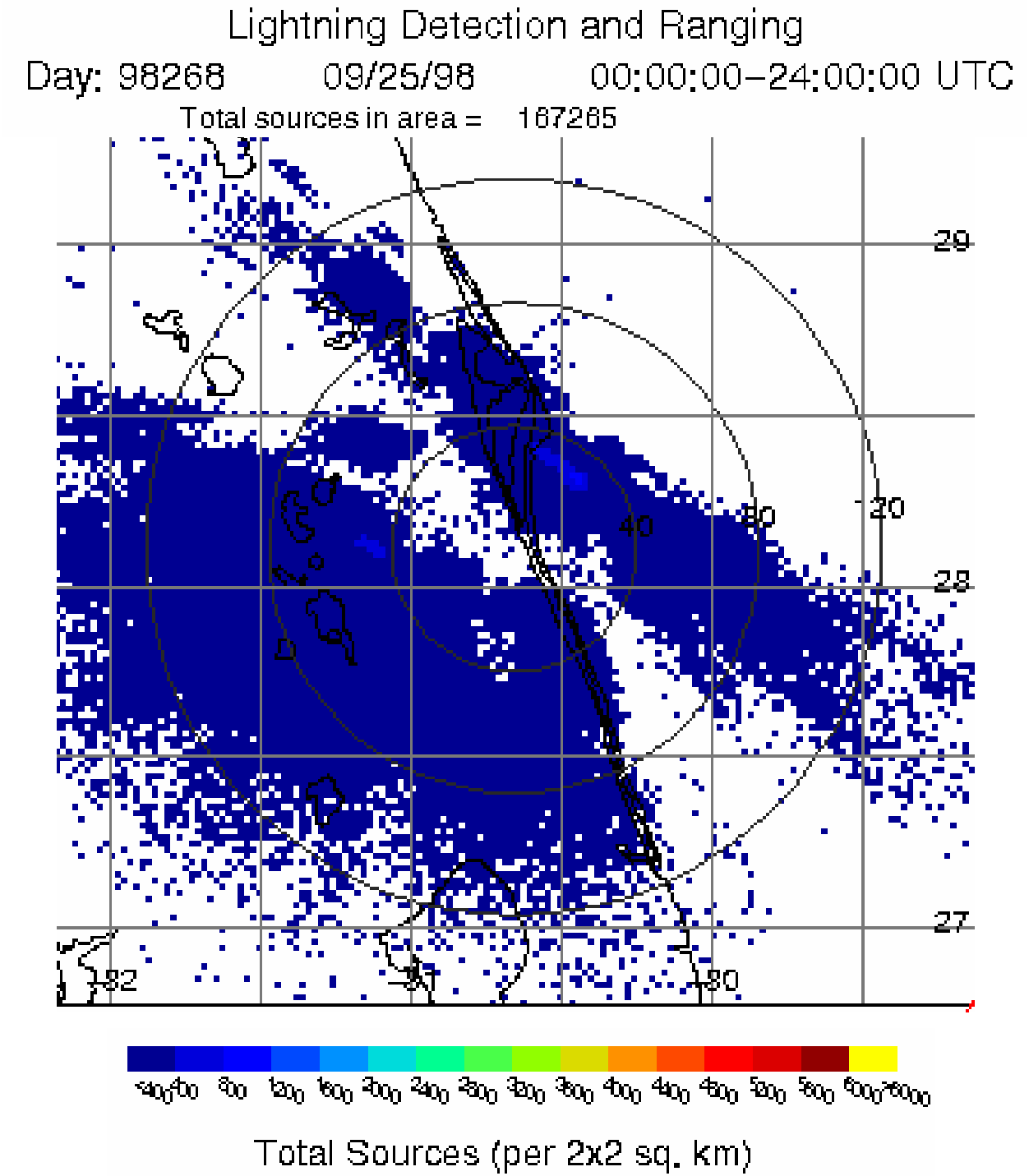




Hurricane Georges (1998) - Tornadic Supercell

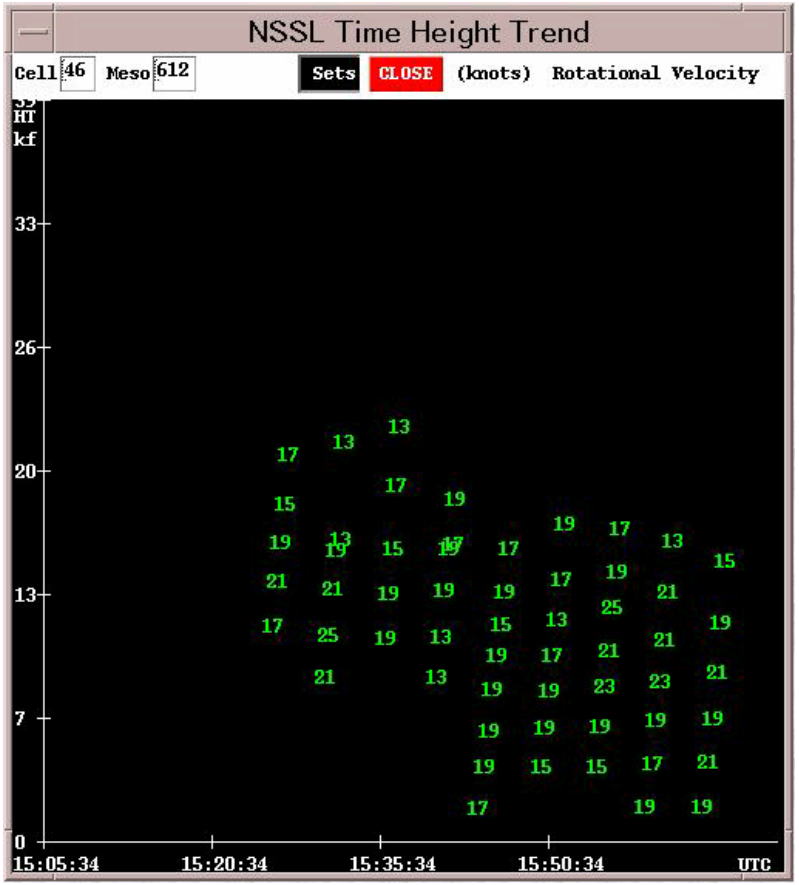


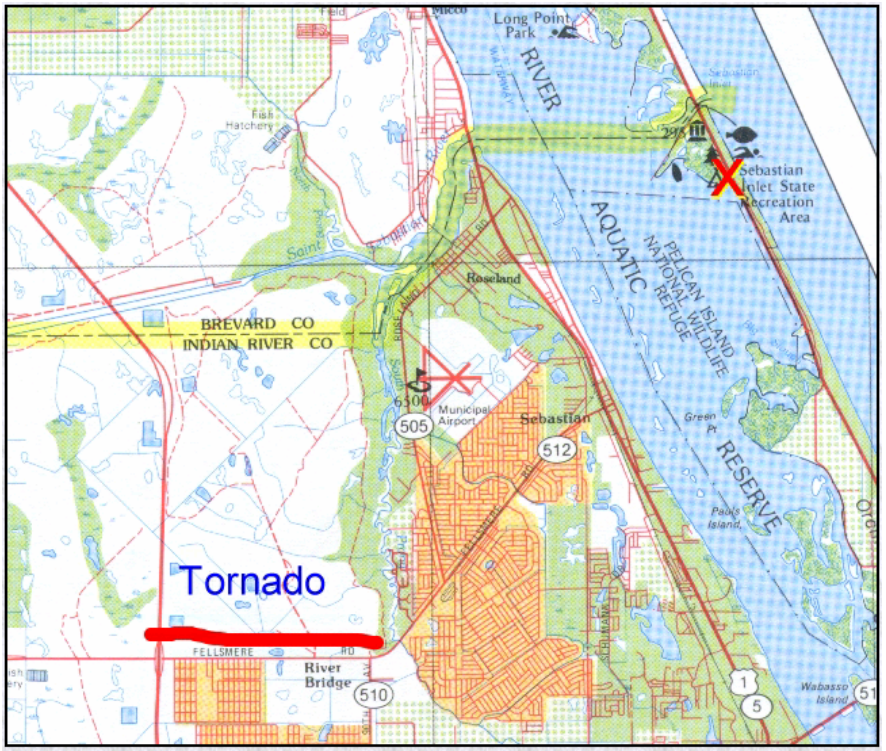



Lightning Detection and Ranging
Day: 98268 09/25/98 00:00:00–24:00:00 UTC
Total sources in area = 167265
29
28
27
20
40
80
82
84
80
<400 400 800 1200 1600 2000 2400 2800 3200 3600 4000 4400 4800 5200 5600 6000 >6000
Total Sources (per 2x2 sq. km)

Hurricane Georges Tornado

1605 UTC 25 Sept 1998





Conclusions

Data examined for TCs Gordon (1994),
Josephine (1996) & others
low buoyancy, high shear environments

- TLI minimal, but often occurred with cells which produced tornadoes (lack of supercooled water due to weak updrafts?).
- CG flashes infrequent & not correlated with tornadoes (equal number of F0's during 'CG' and 'no CG' periods).
- Two relatively long-tracked, strong tornadoes (F2) were totally devoid of TLI! (Vr > 15 m/s, shr > .016 /s, ET > -20C).
- While TLI often absent from cells which did NOT produce tornadoes; absence does not negate tornado threat.
- TLI presence can help identify "suspicious" cells & likely suggests a proxy for strong(er) updrafts (tornadogenesis?).

Questions???

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